Vol. 39, No. 3 September, 1913 Whole No. 147

United States Naval Institute

Proceedings

PUBLISHED QUARTERLY
EDITED BY E. J. KING

U. S. NAVAL INSTITUTE
ANNAPOLIS — MARYLAND

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The Lord Baltimore Press
BALTIMORE, MD., U. S. A.

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CONTENTS

SECRETARY'S NOTES v

ORGANIZATION AND ENROLLMENT OF A RESERVE FOR THE UNITED STATES NAVY AND MARINE CORPS. By Commander H. J. Ziegemeier, U. S. Navy 903

THE BATTLE OF LAKE ERIE, SEPTEMBER 10, 1813. By Robert W. Neeser 921

THE NAVY AND THE PANAMA CANAL. By Captain Harry S. Knapp, U. S. Navy 931

COLUMN AS A BATTLE FORMATION. By Lieut. Commander Dudley W. Knox, U. S. Navy 949

THE NAVAL WAR COLLEGE, THE GENERAL BOARD, AND THE OFFICE OF NAVAL INTELLIGENCE. By Commander W. S. Crosley, U. S. Navy 965

NAVAL STRENGTH IN NAVAL BASES. By Midshipman Edward Ellsberg, U. S. N. A. 975

NAVAL EFFICIENCY AND COMMAND OF THE SEA. By Lieut. Commander Lyman A. Cotten, U. S. Navy 981

THE VENTILATION OF MODERN BATTLESHIPS. By Naval Constructor R. D. Gatewood, U. S. Navy, and Surgeon Charles M. Oman, U. S. Navy 993

THE BOATSWAIN'S CALLS. By Chief Boatswain Stephen McCarthy, U. S. Navy 1009

A DIRECT CAUSE OF LIBERTY-BREAKING. By Commander W. W. Phelps, U. S. Navy 1025

THE DETERMINATION OF A FIX FROM TWO LINES OF POSITION. Dr. Fulst's β Table, a New "Protractor Diagram" and T Square. A New Solution of an Old Problem. By Lieut. Commander Radler de Aquino, B. N. 1031

SEARLE'S METHOD OF FINDING A SHIP'S POSITION. By Lieut. Commander Harris Laning, U. S. Navy 1053

THE TRANSPORTATION SYSTEM OF A NAVY YARD. By R. E. Bakenhus, Civil Engineer, U. S. Navy 1057

SAVING MONEY FOR THE NAVY. By Asst. Naval Constructor C. A. Harrington, U. S. Navy 1065

AN ATTEMPTED CLASSIFICATION OF THE PERSONNEL OF THE U. S. NAVAL DISCIPLINARY BARRACKS, PORT ROYAL, S. C. By W. L. Mann, Ph. B., A. M., M. D., Passed Assistant Surgeon, U. S. Navy 1085

MARITIME AVIATION. By Captain René Daveluy, French Navy, Translated by Lieut. G. M. Baum, U. S. Navy 1097

AMALGAMATION FEATURES OF THE PERSONNEL PROBLEM. By Lieut. Commander Harry E. Yarnell, U. S. Navy 1111

THE REPAIR AND ALTERATION OF SHIPS AS PROVIDED FOR IN THE NAVAL INSTRUCTIONS. By Lieut. Commander T. A. Kearney, U. S. Navy 1127

SCOUTING AND SCREENING OPERATIONS. By Lieutenant W. S. Pye, U. S. Navy 1139

TRADITION AND PROGRESS IN THE NAVY. A Review of Service Opinions. 1841-1901. By Captain Carlos Gilman Calkins, U. S. Navy 1189

A HALF CENTURY OF NAVAL ADMINISTRATION IN AMERICA, 1861-1911. By Charles Oscar Paullin 1217

DETERMINATION BY RADIO-TELEGRAPHY OF THE DIFFERENCE OF LONGITUDE BETWEEN PARIS AND BIZERTE. By MM. Lancelin and Tsatsopoulos, under the direction of M. H. Renan. Translated by Ensign B. S. Bullard, U. S. Navy 1269

DISCUSSION 959, 1305

PROFESSIONAL NOTES. Prepared by Lieut. Commander Ralph Earle, U. S. Navy 1321

LIST OF PRIZE ESSAYS 1369

NOTICE.—Extract from Constitution 1373

SPECIAL NOTICE.—Naval Institute Prize Essay 1374

ADVERTISEMENTS.

U. S. NAVAL INSTITUTE.

SECRETARY'S NOTES.

Changes in the Officers of the Institute.

Commander L. M. Nulton, on being ordered to duty at the War College, resigned from the Board of Control, and that body, on June 7, elected Commander W. W. Phelps to fill the vacancy thus caused. At a meeting held on August 7, Lieut. Commander E. J. King was selected to relieve the present Secretary and Treasurer, who is ordered to sea duty in command of the U. S. S. *Balch*, on September 1. Lieutenant W. A. Hall was elected to the vacant position thus caused on the Board of Control.

Membership.

Since May 20, 1913, 30 regular members and 2 associate members have joined the Institute. The following member has died:

Rear Admiral George Brown, U. S. N., June 29, 1913.

The membership should increase more rapidly, and members are urged to encourage non-members and their friends in civil life to join and thus aid the good work of the Institute. A membership blank is printed in the back of each issue, and each member by seeing that his was used would advance the work and capacity of the Institute greatly.

International Engineering Congress.

The Committee of Management of the International Engineering Congress to be held in San Francisco in May, 1915, has cordially invited officers and members of the Naval Institute to attend and to participate in the proceedings of the congress. The scope of this congress is to be widely representative of the best engineering practice throughout the world, and the papers, discussions and proceedings will constitute an adequate review of the progress made during the past decade, and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work. The secretary is Mr. W. A. Cattell, Foxcroft Building, 68 Post St., San Francisco.

Book Received. Capitan de Fragata Luis Langlois of the Chilean Navy has presented the Institute with a bound copy of his essay on the Influence of Sea Power on the History of Chile. This essay was awarded the first prize in the competition held by the Circulo Naval for an essay to commemorate the national centennial.

The New Supplement to the American Nautical Almanac. The twenty-five page pamphlet entitled "Supplement to the American Nautical Almanac," prepared by the officers on duty at the Naval Observatory under the direction of Captain J. L. Jayne, U. S. N., is a veritable boon to navigators. It contains exactly the information needed in most accessible form. By the tables the positions of the sun and fifty-five of the navigational stars—more than a navigator ordinarily uses—are listed in such a manner as to permit, with simple mental interpolation, the picking out of their positions to within a tenth of a minute of arc in declination, or a tenth of a second of time in right ascension. The correction to the R. A. M. S. being on the same page as the noon value does away with the inaccessible Table III altogether.

The Manual of the Compass. This book, originally compiled by Lieutenant Commander Harris Laning and issued in March, 1913, has been revised and two chapters, one on instruments and the other on the gyroscopic compass, have been prepared by the officers on duty at the Naval Observatory, and added to the book, which has now been approved by the department for issue to the service to take the place of Diehl's Compass Manual. This book should be ready for sale by the 1st of October.

Catalogue of Trophy Flags. A pamphlet, "Illustrated Case Inscriptions from the Official Catalogue of the Trophy Flags of the United States Navy," has just been completed by H. C. Washburn, Instructor, U. S. Naval Academy, and is worthy of particular note.

No officer in the United States Navy can afford to miss this new publication. Patriotic societies, libraries whose policy it

is to foster a popular knowledge of our naval history, and all American citizens who value the heroic traditions of their navy, should see this, the first book of its kind, at once. It is worthy of the serious consideration of those who have in their charge the nation's public and private schools.

An object lesson in patriotism, it is a register, compact, authoritative, illuminating, in which the flags captured and fought under in our wars *speak for themselves* and tell their deathless stories of deeds known, but only half remembered; of actions and feats of arms on the high seas long forgotten. It is the result, unmistakably, of scholarly research among original sources, inspired by a patriotic desire to give the splendid traditions of the naval service their due dignity as a living heritage.

Any attempt to give here an idea of the array of flags is unsatisfactory. There are British ensigns in numbers unbelievable, and the only British Royal Standard ever captured; tricolors of France; eagle flags of Mexico, and the blood-red ensigns of Algiers; the red and gold and armorials of Spain; side by side the ensigns of the Confederate ram *Albemarle* and the U. S. S. *Kearsarge;* the ensign and jack of the *Maine;* gorgeous bannerettes of Korea; a Chinese pirate flag; a Boxer artillery flag; a King George III cavalry guidon; the flag of the *Saginaw's* gig; Oliver Hazard Perry's battle-flag, with its watchword, the dying words of James Lawrence, "Don't Give up the Ship!"; the first U. S. ensign hoisted in Japan, by Matthew Calbraith Perry. In all there are 173 flags pictured, and the story of each is told—trophies of the navy's honor roll of historic victories.

The Ship's Commissary.

The question of securing good fare in the ship's general mess at a reasonable cost is being given extra attention just now in the department and in the fleet. The Institute is publishing, separately from the PROCEEDINGS, and for the use of the service, a timely pamphlet on the subject by Paymaster G. P. Dyer entitled "The Ship's Commissary Officer." This covers commissary work afloat in the same way that Paymaster Dyer treated that of storekeeping in "The Ship's General Storekeeper" recently published in the PROCEEDINGS. The commissary pamphlet can well be made use of by commanding and executive officers as well as by young pay officers, in acquainting themselves with the

details of a successful system for running the general mess. Many practical hints may be obtained from it. The data in the appendix of the pamphlet is particularly valuable for its specific information as to quantities and costs of items used in a sufficient bill-of-fare, and how it may be given the maximum variety. Throughout, the aim has been to avoid repeating matter already in print in regulations, orders or instructions, and to condense the pamphlet to suggestions of a nature which have not before been accessible to officers without experience in commissary work. The practical character of this information is shown by the synopsis of the pamphlet given in the advertisements of books following.

Mechanics.

Professor H. E. Smith has written for the use of midshipmen a book on mechanics.

The aim of the author has been to present the fundamental principles of the subject in logical order, using language *free from technicalities* so that it may be *clear to the beginner.*

Special topics are so arranged as to permit the omission of one or more without breaking the continuity. Engineers' units have been adhered to throughout, and numerous problems have been solved in the text with reasons for the separate steps given in detail.

Revision of Text Books.

Commander H. O. Stickney has revised Barton's Naval Engines and Machinery, which will be ready about November. Commander S. S. Robinson has revised his Wireless Telegraphy, bringing it up to date. This revised edition should be ready by October 1.

ANNAPOLIS, MD., AUG. 20, 1913.

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THE BATTLE OF LAKE ERIE.—THE U. S. S. NIAGARA BREAKING THROUGH THE BRITISH COLUMN.
From the painting by Mr. Carlton T. Chapman, now on exhibition at Toledo, Ohio.

UNITED STATES NAVAL INSTITUTE PROCEEDINGS.

Vol. 39, No. 3. SEPTEMBER, 1913. Whole No. 147.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ORGANIZATION AND ENROLLMENT OF A RESERVE FOR THE UNITED STATES NAVY AND MARINE CORPS.

By COMMANDER H. J. ZIEGEMEIER, U. S. Navy.

In submitting the following article no attempt is made at proposing anything new, but simply to invite attention to one of the most important needs for the navy and marine corps. It is written in order to bring the matter to the attention of the service; to stimulate interest and arouse discussion as to the best method of solving the problem. The ideas have been in the minds of officers, many of whom have expressed them in articles, and various measures and means have been suggested at different times to satisfy the situation. The title, "Organization and Enrollment of a Reserve for the United States Navy and Marine Corps," explains the object advocated in this paper. The object of the navy is to be ready to fight in time of war, and to this end it must prepare in time of peace. A war will require many additional men and means to provide them must be formulated and prepared in advance. In the Civil War the personnel of the United States Navy increased from 7000 men to 58,000 men at the close. In the war with Spain the numbers were doubled. Upon the preparation beforehand will depend the result of the conflict. At the present time we cannot put the entire available ships in commission and on a war footing, owing to lack of personnel, and we have no plan for obtaining men in case of necessity. To supply the necessary number there are two ways: one is to main-

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THE BATTLE OF LAKE ERIE—THE U. S. S. NIAGARA BREAKING THROUGH THE BRITISH COLUMN.
From the painting by Mr. Carlton T. Chapman, presented to the Institute.

tain the entire navy on a war footing; the other is to provide an adequate naval reserve. No nation maintains afloat in time of peace the matériel and personnel required in war. Such a policy would involve enormous expenditures and is out of the question. We must, therefore, turn to the second method and study the best means of bringing this about.

In a country where military service is obligatory all difficulties in the formation of a reserve are definitely removed; not so where the service is voluntary, as in the United States. Here the problem is an entirely different one and certain inducements must be offered to arrive at a satisfactory solution.

Our Navy Department is fully cognizant of this need, as will be pointed out. The Secretary of the Navy, in his annual report of 1911, strongly urged the creation of an adequate reserve of personnel. In 1909 a bill drawn up by the department was introduced in both the Senate and House of Representatives. The same bill was again introduced in the Senate on December 11, 1911. The Navy Department, in the spring of 1912, urged the passage of this bill and indicated the necessity therefor, but no Congressional action was taken.

The need for a reserve of personnel organized under federal laws is imperative, so that in time of war or threatened hostilities the necessary men may be subject to the call of the President of the United States and so bring the personnel of the navy to its proper strength. To this end it is highly desirable that the officers and men taken in may be men of nautical training and experience.

In time of war, when every ship fit to be commissioned will be placed in active service, the personnel requirement will increase enormously; our present strength will not be sufficient to meet the demands of the navy, and its main reliance for obtaining trained men at short notice, exclusive of the naval militia, will be from men in civil life who have served in the navy, and who have been discharged and recommended for re-enlistment. To these may be added seafaring men, who, by the nature of their calling, may be formed into some branch of the service; besides these, there are other classes of men, who, although they have had no experience at sea, would be of value to the navy and useful on board ship if given corresponding duties. These men are engineers, firemen, electricians, telegraphers and artificers of various

grades. Men discharged from the naval militia would also be available for enrollment in the naval reserve.

Lately the United States Navy has inaugurated a policy of keeping the battleships, armored cruisers, cruisers, gunboats and destroyers that are not with the fleet in reserve, some in first and some in second reserve. By this policy all our ships, old and new, are kept in condition for service, a most excellent arrangement. For the upkeep of these vessels reserve complements are placed on board. No one will deny that while these ships are ready for sea they are not ready for battle; but to keep them in commission would require more officers and men, greater cost of maintenance, fuel, etc., and it is cost which limits the size of our naval establishment.

The value of a naval reserve has long been recognized by all leading nations, whether their enlistment in time of peace is voluntary, as in England, or compulsory, as in Germany, France, Russia, or Japan. The United States is the only first-class naval power at the present time without a reserve.

FOREIGN NAVAL RESERVES.

Space will not permit going into detail regarding the organization and composition of the naval reserves of the various foreign nations, although it may be profitable to consider these in a general way. There must necessarily be a difference in the method of forming a reserve in countries where service is voluntary and in those where military or naval service is obligatory. Great Britain belongs to the former class and our method of forming a reserve must therefore more nearly approximate hers. To the latter class belong Germany, France, Russia, Italy, Japan, etc. Let us now consider briefly the naval reserves of a few of the leading nations.

GREAT BRITAIN.

In Great Britain there are (a) the royal naval reserve (Act of 1859), which is recruited from the merchant marine; (b) the royal fleet reserve, recruited from men who have served in the navy and whose time has expired; (c) coast guard service, recruited from the navy and naval reserves; (d) royal naval volunteer reserve, recruited from the general population; (e) colonial reserves. Of these (a) and (b) are unorganized, but report for drills at specified times and for certain periods in ac-

cordance with admiralty regulations. The coast guard serve in connection with the life-saving, quarantine and light-house service. They may serve in the navy if called upon and then be returned to the coast guard. The royal naval volunteers are organized into divisions and would be the last to be called into service.

In May, 1912, Great Britain formed a new class of naval reserves made up from seamen, firemen, and marines under 32 years of age who had previously served in the royal navy and who at present belong to the royal fleet reserve. This class will be known as the immediate class of the royal fleet reserve, and is to be a small but highly trained reserve, immediately available by the admiralty in an emergency. For the present this immediate reserve is limited to 5000 men. Men belonging to this reserve will not be allowed to leave the country, and those whose work requires their leaving, such as men in the merchant service, will not be eligible for this class of reserves. These men will be given 28 days training each year, and the admiralty has sent out notice to the employers of such men asking for their co-operation and to keep the places open for these men during the time of yearly training, as the adequate training of the reserve is a matter of national importance.

The following was the strength (officers and men) in the various classes on January 1, 1912:

(a) Royal Naval Reserve[1]	21,534
(b) Royal Fleet Reserve	24,082
(c) Coast Guard	3,048
(d) Royal Naval Volunteers	4,100
Total	52,764

[1] Includes Colonial Reserves.

The total number of officers and men in the regular navy was about 134,000.

At the present time Great Britain is advocating its royal fleet reserve on the ground of efficiency at moderate cost, and it is undoubtedly the reserve upon which the greatest reliance and hope are placed.

GERMANY.

In Germany military or naval service is compulsory, every German citizen being subject to service in either the army or navy from the completion of his 20th year to March 31st of the year in which he completes his 39th year. Service is apportioned

in the following manner; active service lasts three years, then follow four years of reserve. During the reserve service the men's addresses are left at the naval stations where they entered and an accurate register is kept at all times. After four years of reserve they pass into the "See-wehr" for five years and then for seven years into the "Naval-Ersatz" reserve service. After that, and until their 45th year, they pass into the "Landsturm," which is an emergency reserve. No exact data are available as to the number of men in each class of reserve.

Naval service is required of the people among the seafaring or semi-seafaring population. There are also volunteers of "one-year" service, who are mostly men of education or technical experience. The German Imperial Navy Office has of late been successful in obtaining many volunteers.

A number of officers of the Hamburg-American and North German Lloyd hold commissions in the naval reserve. The German Emperor has recently inaugurated a progressive movement towards getting more out of the reserve than has been the case up to the present.

FRANCE.

France has both voluntary and compulsory service. The reserve officers come from retired officers who have served less than 25 years and who at their own request join; also from captains and chief engineers of the merchant service. They are attached to various districts, and in case of mobilization report to the commandant of their district. Reserve officers can be called out every two years for a period of instruction not to exceed four weeks.

As in Germany, military or naval service is mainly compulsory in France. The period of service is from 18 to 50, divided into three periods. The first period is from 18 to 20, but during this time recruits can only be called out in time of war. The second period lasts seven years, five of active service and two on waiting orders. The third period lasts until the age of 50 years is reached.

France has various regulations regarding periods for which the reserve may be called out for drills, gratuities, pensions, etc., to which the different classes of reserves are entitled.

JAPAN.

Japan has both conscription and voluntary enlistment. Men who have completed their term of service pass into the first and

afterwards the second reserve. Compulsory enlistment is for four years, after which are required three years in the first reserve and five years in the second reserve. Voluntary enlistment is for six years active service and ten years in the first reserve. Officers and men of the merchant service are also enrolled in the reserve.

UNITED STATES ARMY RESERVE.

In accordance with the Army Appropriation Bill, approved August 24, 1912, the formation of a regular army reserve is provided for, and after some years the army will have such a reserve. This bill provides that after November 1, 1912, all enlistments in the regular army shall be for a term of seven years, the first four years being with their organization and the last three on furlough and attached to the army reserve. After four years continuous service a man may re-enlist for seven years, in which case he receives his discharge from his prior enlistment. At the expiration of three years continuous service, either under a first or any subsequent enlistment, upon written application, a man may be furloughed and transferred to the army reserve, at the discretion of the Secretary of War, in which event he is not eligible for re-enlistment until after the expiration of seven years. In computing continuous-service pay four years count as an enlistment period. The bill provides:

> That hereafter the army reserve shall consist of all enlisted men who, after having served not less than four years with the organizations of which they form a part, shall receive furloughs without pay or allowances until the expiration of their terms of enlistment, together with transportation in kind and subsistence as provided for by this act in the case of discharged soldiers, but when any soldier is furloughed to the reserve his accounts shall be closed and he shall be paid in full to the date such furlough becomes effective.

By this act a man may, however, complete the whole of his seven years enlistment without passing into the reserve. Except upon re-enlistment after four years service, no enlisted man receives his final discharge until at the end of seven years. It also provides that any person honorably discharged from the regular army with good character, and if physically qualified, if not over 45 years of age, may be enlisted in the army reserve for a period of three years.

With reference to the employment of the reserve the act provides:

That in the event of actual or threatened hostilities the President, when so authorized by Congress, may summon all furloughed soldiers who belong to the army reserve to rejoin their respective organizations, and during the continuance of their service with such organizations they shall receive the pay and allowances authorized by law for soldiers serving therein; and any enlisted man who shall have re-enlisted in the army reserve shall receive during such service the additional pay now provided by law for the soldiers of his arm of the service in their second enlistment period. Upon reporting for duty, and being found physically fit for service, they shall receive a sum equal to five dollars per month for each month during which they shall have belonged to the reserve, as well as the actual cost of transportation and subsistence from their homes to the places at which they may be ordered to report for duty under such summons.

The carrying out of the provisions of this act marks the beginning of the formation of a reserve for the army, and these of trained men. Whether it will make any difference in enlistments will be watched with interest, and the navy can profit by observing the advantages and disadvantages of forming a reserve by this method. At the present time the law has been in operation too short a time to justify one in forming definite conclusions, but many objections have been made against it, especially on the ground that the number of enlistments has been decreasing since the law went into effect.

PROPOSED NAVAL RESERVE BILL.

For the information of those who are not familiar with the bill introduced in the 62d Congress, 2d session, its principal features will be pointed out, but without going into details.

The United States Naval Reserve is to be made up of men who have been employed in a seafaring life and others who may be deemed by the Secretary of the Navy well adapted for the naval service, provided all enrolled agree to respond to a call by the President in time of war or when war is threatened. The period of enrollment is for five years; but no person shall be enrolled the first time who is over 40 years of age, and the enrollment of all persons who enroll between the ages of 40 and 45 shall terminate at the age of 45.

In time of war those enrolled shall be subject to the call of the President of the United States for service in the United States Navy for a limited period not to exceed two years. Members of the naval reserve may voluntarily enter active service for drills, exercises, etc., as may be prescribed by the Secretary of

the Navy, for a period not to exceed one year at any one time, during which time they shall receive the same pay and allowances as officers and men of like rating.

The naval reserve is to consist of:

Line officers not to exceed 50 per cent of the commissioned line officers of the regular navy, to be controlled in the grades of lieutenant, lieutenant junior grade, and ensign, of whom not more than 25 per cent shall hold the rank of lieutenant; the number of lieutenants and lieutenants junior grade shall not together exceed 50 per cent and the remainder shall be ensigns; officers who have resigned from the regular navy with a higher rank than that of lieutenant shall be enrolled in the naval reserve in the rank held in the regular service at the time of resignation, the numbers in such higher ranks to be deducted from the number of lieutenants.

Line officers are limited to:

(a) Officers who have resigned from the navy in good standing within ten years;

(b) Graduates of the Naval Academy who have never been commissioned, but who left the service in good standing within ten years;

(c) Officers of the merchant marine, yachtsmen and other seafaring men who hold masters' certificates for seagoing vessels;

(d) Naval militia officers who have served four years in the said militia and who have been honorably discharged within ten years.

Medical officers as assistant surgeons with the rank which assistant surgeons of the regular service have upon entry.[2]

Pay officers in the junior ranks and not to exceed 50 per cent of the commissioned pay officers of the regular navy.

Warrant officers, not to exceed the number of machinists in the regular navy.

Petty officers and men, not to exceed 50 per cent of the total authorized enlisted strength of the regular navy to be enrolled from men discharged from the navy and recommended for re-

[2] Congress has since established a naval medical reserve corps similar to the medical reserve corps for the army, so this paragraph may need modification.

enlistment; seafaring men; men honorably discharged from the naval militia; artificers and men of special callings.

The names of officers of the naval reserve are to be borne in the navy register and officers of the reserve commanding private vessels under the United States flag are allowed to fly a naval burgee. When officers of the naval reserve are called into active service during war the President shall issue them a regular commission for service during the war, and all petty officers and men shall be regularly enlisted in the navy in time of war.

Every petty officer and enlisted man in the naval reserve receives an annual compensation of ten dollars at the end of each year of enrollment. Every officer and man in the naval reserve is to be furnished with a distinctive button which may be worn with civilian dress.

There are other sections relating to promotion in the reserve, uniform, exemption from jury duty, application of pension laws for disabilities received in service, etc.

NAVAL MILITIA BILL.

Another bill considered at several sessions of Congress, again introduced in April, 1912, and favorably reported by the Naval Committee of the House on May 16, 1912, is the Naval Militia Bill. This bill, the passage of which was strongly recommended by the Secretary of the Navy in his annual report, contemplates an organized naval militia, which, *in time of war,* will be under federal control. The bill establishes as far as practicable the same relation between the regular navy of the United States and the organized naval militia as exists between the regular army and the national guard under the terms of what is known as the Dick Bill. It does not contemplate that the naval militia shall enter the regular naval service in time of war as separate and distinct organizations in charge of our armed vessels, but that the organizations may be divided up and officers and men assigned to vessels of the fleet as may be necessary. In the event of war the President is to have authority to call on these men for service. It is not necessary here to go into the various features of the bill.

Each of these bills has the department's approval and their passage has been urged by the Secretary of the Navy. Each is intended to create a reserve. The Naval Militia Bill has been before Congress during several sessions and was favorably reported

by the House. It will undoubtedly come up again and will receive the active support of the entire naval militia. There is at the present time a very small percentage of discharged men among the enlisted personnel of the naval militia, and it is doubtful if the passage of their bill would bring additional ones, although it would attract many whose services would be of value to the navy in time of war.

It is not to be understood that this article is an argument for the reserve bill outlined above over any other method of forming a reserve. It is referred to here because it has been introduced several times in Congress. Whether it is desirable to create a reserve by this bill, by a modified form of it, or on plans of the army reserve,[8] is a matter for the Navy Department to decide. The Secretary of the Navy has recommended the Naval Reserve and the Naval Militia Bills.

The necessity of having a naval reserve is apparent and a proper reserve will have to be organized and enrolled upon general plans advocated by the department, but no time should be lost in its creation.

Since 1905 there have been the following discharges and re-enlistments in the navy and marine corps.

Year	Men discharged and recommended for re-enlistment		Total number of men re-enlisted	
	Navy	Marine Corps	Navy	Marine Corps
1905	3,929	1,888	2,413	554
1906	5,147	904	2,218	308
1907	6,515	1,334	2,102	404
1908	7,142	973	4,077	566
1909	6,203	1,407	4,030	796
1910	6,302	1,446	3,841	623
1911	6,752	1,872	3,849	638
1912	11,432	1,892	6,227	765
	53,422	11,716	28,757	4,654
	28,757	4,654		
	24,665	7,062	53.8%	39.7%

[8] President Taft in his message of December 6, 1912, referring to the regular army reserve, stated: "The legislation is imperfect, in my opinion, in certain particulars, but it is a most important step in the right direction."

From this it will be seen that during the last eight years there are 24,665 men in civil life discharged from the navy and 7062 from the marine corps available for the naval reserve, an average of about 3083 per year for the navy and 883 for the marine corps. During the last ten years 87 line officers and 115 midshipmen have resigned who are eligible for enrollment. These numbers would, of course, be reduced on account of age, physical disability, death and other causes, but it is believed that a large percentage would respond to a call in case war threatened, although at present the Navy Department is not in touch with these men and their whereabouts are unknown. If a reserve is created, its object should be pointed out to all men prior to discharge, and, if they desire, they should be allowed to enroll immediately after discharge if they are not going to re-enlist.

As far as possible our naval reserve at the start should be made up from men discharged from the navy and marine corps. There are many seafaring men on the Great Lakes among whom enrollment can be made, but it is not believed that it would be desirable in the beginning to enroll from the seagoing merchant service or from our coastwise steamers. In a war many of these vessels would be taken over as auxiliaries, and unless their crews were retained on board their places would have to be filled from the naval reserve. Moreover, commerce and trade should be interrupted as little as possible. Volunteers with zeal and enthusiasm having no sea experience, but acquainted with naval arms in addition to their own professional attainments, would constitute a very desirable reserve, but this body should at first be small and efficient, rather than large and unreliable.

Although Great Britain has had an organized naval reserve for many years, she realizes that the mobilization of her naval forces is dependent upon the royal fleet reserve, it being the only reserve upon which a reliance for efficiency can be placed. In spite of all efforts on the part of the admiralty to encourage the enrollment of volunteers for the royal naval volunteer service, the result has been too uncertain to place a great dependence upon this reserve. Neither must we be content in supposing that in time of war we can draw upon our merchant service for large numbers. Even if we could get the *numbers* needed they would still have to be trained to meet service conditions. In 1911, out of a total

of 192,191 [4] men shipped and re-shipped there were 59,802 Americans (born), 31,810 naturalized and the rest foreigners, this being about 47 per cent of the total, and this has been practically constant during the last seven years. In our coastwise steamers only a small per cent of Americans (except those who have good prospects of being officers) remain any length of time.

The United States will soon have a reserve fleet of battleships, armored cruisers, cruisers and torpedo-boats. The reserve fleet, as regards matériel, has been placed in efficient condition and ready for service, but unless the necessary crews are ready and available to be called out in time of war these ships would be of little value. In the hearings before the Naval Committee on January 9, 1912, the Chief of the Bureau of Navigation pointed out that on April 1, 1912, in order to maintain in commission the fleet of 21 battleships, the cruisers, gunboats, destroyers, submarines, etc., and vessels in reserve with their reduced complements, there was an approximate shortage of 4000 men. In the same hearing it was shown that it would require to man all the serviceable vessels 66,194 men, or 18,694 more than the allowed strength, (47,500).[5] In time of war where are the trained men to fully commission our ships to come from? Additional men would be required for the ships already in commission. Unless we have a reserve our reserve ships cannot be fought. If we had a trained reserve ready to be called out and placed on board these ships to fill the complements with the reduced crews already on board, and if these reduced crews in time of peace could be increased, a great advance in our preparedness for war would be made. To be prepared for war supposes both men and matériel available. When men are wanted in time of war or threatened war they will be wanted quickly, and it is highly desirable that the men required to man our naval vessels should be trained men, and these can only be obtained by having a proper naval reserve.

OUR NAVAL MILITIA.

At the outbreak of the Spanish-American War the naval militia furnished 3332 officers and men, which grew to about 5500 by the end of the war. The naval militia, as it exists to-day, is a

[4] Report of the Commissioner of Navigation, 1911.

[5] Act approved Aug. 22, 1912, increased the enlisted force 4000.

highly efficient service, but it has its limitations, and as organized at present cannot be considered as a reserve.

Militia is a state institution, whose officers are elective and whose commissions are issued by the state executive. The national government's relation to the militia is one of encouragement. The national government exercises no control except in a very general way, but can withdraw aid if certain requirements or standards are not attained.

A reserve, in a military sense, is a body of officers and men under federal control, with the idea of using them principally in time of war, and who, as far as possible, have had previous training in the navy. The President issues commissions to the officers and the whole or any part of the reserve is ordered into service as a part of the regular navy.

In countries where compulsory military service is required the men after discharge are placed into reserves known by different names in different countries, constituting a first, second or third reserve, the principal point being that the officers and men are subject to military or naval service until they reach a certain age, and have to report each year for a specified term of instruction, depending upon the class of reserve they are in. Such is a true military or naval reserve. The naval militia would undoubtedly furnish many valuable men when called upon in time of war, but it is not a reserve in the technical military sense. The naval militia is composed of a body of men whose zeal, patriotism and intelligence is of a high order, and their services as individuals in time of war would be of great value, but there are necessary limitations to their services. The passage of their bill will form a valuable source to draw on in time of war, but will not provide sufficient men for a proper naval reserve.

COST.

The Naval Reserve Bill before Congress appropriates two hundred and fifty thousand dollars for the purpose of paying the expenses connected with the enrollment, training, instruction, uniform and equipping of the naval reserves. In any bill requiring Congressional action the money involved forms an important item, especially at the present time, when economy is the policy of Congress and retrenchment and reduction in army and navy matters are to bring about some of this economy. For the

purpose of forming some estimate of the money required let us see what the approximate cost would be.

Taking the *Navy Register* of January 1, 1913, the maximum personnel allowed under the provisions of the bill as introduced would be 1109 commissioned officers, 224 warrant officers, 25,750 enlisted men and 4960 marines. The following table shows their distribution and pay, the latter being calculated in each grade for one month at the lowest sea pay in such grade.

213 Lieutenants	$46,840
213 Lieutenants, Junior Grade	40,896
427 Ensigns	66,613
146 Asst. Surgeons	28,032
110 Asst. Paymasters	17,160
224 Warrant Officers	28,000
	$227,541

Owing to various ratings in which the enlisted personnel will be enrolled and distributed, it is more difficult to form a correct estimate of the cost. If, however, we use an average of $40 per month for each enlisted man in the navy and $30 per month for each enlisted man in the marine corps, it is believed that the estimate will be ample. Using these rates of pay per month we have:

25,750 Enlisted men at $40 per month	$1,030,000
4,960 Marines at 30 " "	148,800
Total enlisted men's pay	$1,178,800
Total officers' pay	227,541
Total	$1,406,341

If we add to this the $10 per year for each enlisted man we will have:

25,750 Enlisted men in the navy at $10 per year	$257,500
4,960 Marines at $10 per year	49,600
	$307,100

Total expense for one year $1,713,441,* for 32,043 officers and men, or about $53.47 per capita. This represents the maximum for pay for a reserve of 1333 officers and 30,710 men—a modest amount for a trained personnel of that size.

This maximum authorized strength will not be attained for years to come, as at first only discharged men from the navy and

*Expense of transportation is not included in this estimate.

marine corps should be enrolled, and in no year will every member of the reserve be able to report for one month's training. If 20 per cent of the full reserve can report for a month's instruction, and it is not believed that it will exceed this, the pay would be $281,268 per year. Adding to this the $10 per year for each enlisted man ($307,100) makes $588,368. It is, therefore, believed that $600,000 will cover the expenses per annum for maintaining the naval reserve, and that the amount appropriated in this bill ($250,000) will be ample for the first year.

In Great Britain's navy estimates for 1912-1913 the total estimate for the different classes of naval reserves amounts to $3,001,161, this for a force of about 52,000 officers and men, making about $57.71 per capita. Service being voluntary, certain retainers and other inducements must be offered.[1] In countries having universal military service no retainers are allowed, but it is usual to give the pay of the grade for the time they are serving. No comparison of cost of a reserve can therefore be made between these countries and those having voluntary service and where all the estimates are published.

ORGANIZATION AND ENROLLMENT.

A register of the addresses of all discharged men should be kept in the Navy Department, and if a naval reserve bill becomes a law circulars should be sent to them stating the requirements, conditions, places at which they may enroll, etc. All this is an administrative measure and presents no difficulties. We have recruiting offices throughout the United States and little extra expense would be incurred by this enrollment. After the reserve is established the department could have the officers and men in their proper ratings assigned to vessels in reserve or commission, so that each man would know beforehand where he would be expected to report if called into service. The United States should be divided into districts, each to comprise several states. In each district there should be an officer, who should get into communication with all ex-naval officers, graduates of the Naval Academy and discharged enlisted men, with a view to having them enrolled in the naval reserve.

[1] The *Naval and Military Record* of October 26, 1910, gives the per capita cost per year as follows: Royal Naval Reserves, $43.74; Royal Fleet Reserve, $30.12; Royal Naval Volunteer Reserve, $24.30.

Once a naval reserve is established a card index could be kept of each man, his residence, place of business, trade, rank or rate best qualified to fill, and his assignment in case of call for service. Orders could be made out with the dates in blank, to be filled out when called into service. Arrangements could be made with railroad companies, so that, by presenting their orders to the nearest agent, transportation to the designated place would be furnished. In this way the reserves could report in a very short time.

Owing to the large extent of our country and the various occupations of discharged men in civil life it will be difficult to get many volunteers for regular drill and instruction each year. Although very desirable, *if the training is on board regular vessels and under service conditions,* such training is not absolutely essential.

A reserve, strictly speaking, must consist of matériel as well as personnel. Matériel can be bought, but personnel must be trained in time of peace, and in these days, when great technical knowledge is essential, it is obtained only by prolonged training. A large fleet of ships without adequate trained and drilled officers and men will be of little use in the day of a crisis and will only invite disaster. Success will depend upon the time it takes to mobilize, and to do this expeditiously all preparation must have been made beforehand in time of peace.

Discipline forms a part of the training and is an important factor for efficiency, and efficiency is more important than numbers, and previous training on board ship contributes towards this end. Men who have served one or more enlistments in the service will form the most efficient reserve that can be organized. A committee headed by Admiral Tryon, R. N., in 1892 observed that "the units of a force may personally possess every necessary quality, but to render these units, when massed together, reliable it is necessary that there should be cohesion and solidarity in the force, in order that it may be inspired with that justifiable confidence and unity of action which go so far to ensure success." Commenting upon this sentence the report of the Naval Reserves Committee in Great Britain, 1903, stated: "The usefulness or otherwise of naval reserves depends very greatly upon the extent to which they will promote or impair this cohesion and solidarity on board ship when called upon to serve in time of war, and this in turn will depend upon the knowledge they have previously obtained of the requirements of discipline on board a ship of war

and upon their readiness to fulfill them." The United States needs a large navy, one that must increase in matériel and personnel. To have a reserve ready to call into service in time of war we must provide a naval reserve made up to the greatest extent possible from among the men who have had training on board ships of the United States Navy.

A modern man-of-war is a complicated machine, requiring men of experience and training, and this must have been obtained under continuous-service conditions. While occasional drills make an excellent beginning in training, our first reserve, which will supply our fighting fleet, must be made up of men who have been discharged from the service and recommended for re-enlistment, beginning with those most recently discharged; an effort should be made to first enroll only such men as have been seasoned by the two or three years training, men who are accustomed to the discipline and who know how to look out and care for themselves on board ship. It must be a personnel whose nerves and character have been formed, who in time of peace have acquired the practical knowledge to care for the matériel so as to use this to the greatest advantage in time of war.

These are the men to make up the personnel of our reserve, to whom every encouragement and inducement should be offered to enroll themselves, so that when it becomes necessary to call out a reserve they will at once fit into their assigned billets. If sent to the reserve ships they are the men who in the shortest time can be formed into a cohesive whole and produce the necessary team work to make the ships ready for battle. The necessity for a trained reserve of personnel for the United States Navy is one of the most important subjects that demands our attention to-day if we wish the navy to be ready for war. Unless, however, the service itself wakes up to a realization of this lack of preparation it is not to be expected that the necessary Congressional aid will be forthcoming. To the end of securing a reserve for the navy and marine corps made up of these men let us unite our earnest endeavors and we will possess a real military naval reserve, and, if Congress passes such a law, no effort or labor should be spared to promote its efficiency and contentment.[8]

[8] Since this article was written an officer has been detailed by the Navy Department to take general charge of all matters concerning the organization and creating of a naval reserve with a view to presenting the matter to Congress and obtaining the necessary legislation.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE BATTLE OF LAKE ERIE, SEPTEMBER 10, 1813.

By ROBERT W. NEESER.

"We have met the enemy, and they are ours." In these memorable words Perry, on September 10, 1813, announced to General Harrison his victory over the British squadron off Put-in Bay. Never was good news more welcome. For the fortunes of the Americans on the northern frontier were ebbing low, and upon the outcome of that meeting between the hostile squadrons upon Lake Erie depended success in that region once and for all.

Oliver Hazard Perry's entrance upon the duty for which he had applied, and to which he finally was ordered by the authorities in Washington, was most auspicious. He joined Commodore Chauncey on the lakes at just the right moment, and from that minute whatever he touched seemed to take the direction he wanted. The sailors called it his luck, and superstition never survived more obstinately than their faith in that luck. But this extraordinary advantage was not gained by Perry without labor, energy, courage, and wearing anxieties and disappointments. Of these he had his full share, but no more; and his opponents were in that respect no better off than he.

The situation on Lake Erie at the close of the campaign of 1812 was far from favorable to the American cause. The British squadron under Captain Finnis enjoyed undisputed control of the Lake and its shores. Perry, on the other hand, was confronted with the problem of an inferior and divided force. For when he reached Presqu'isle, he found that the vessels at his disposal there consisted of but two brigs, a schooner, and three gunboats, all still on the stocks, which the contractors could promise for service not earlier than June, while the available craft afloat, including the prize brig *Caledonia,* were at Black Rock in the Niagara River, unable to move on account of the British fort opposite Buffalo and Finnis' squadron on the Lake.

The task of the British commander was, therefore, to maintain these original advantages, by preventing the Black Rock division from gaining the Lake, and maintaining his own squadron in such a position near Presqu'isle (Erie), that the vessels under construction there would be prevented from crossing the bar obstructing that harbor.

Before the opening of the next campaign on the lake frontier, in 1813, the American authorities fortunately awoke to the fact that any further movement for the recapture of Detroit and the invasion of Canada would have to depend upon the naval control of Lake Erie, and that that in turn depended in a large measure upon their own superiority on Lake Ontario. A plan was therefore urged by Commodore Chauncey which, being duly acted upon by the combined naval and military forces, resulted in the capture of the important British positions at York and Fort George, and in the evacuation by the enemy of their controlling defences opposite Buffalo. The first two steps in Chauncey's program had now been successfully taken. The British had been driven from the Niagara River, and the vessels at Black Rock at last were free to move. Preparations had already been made beforehand in anticipation of a victory, and the minute the enemy, in their retreat, abandoned Fort Erie, Perry was on hand to hasten the departure. With great physical labor, the vessels were tracked by oxen up against the current of the Niagara, here setting heavily toward the falls. On May 27 the British evacuated the opposite shore; on June 12 the vessels were above the rapids, but even then this could not have been accomplished had not the sailors had the assistance of several hundred soldiers furnished by Dearborn. These circumstances well show how hopeless the task would have been had the enemy remained in possession of Fort Erie.

Loaded with stores the little squadron, consisting of the *Caledonia, Somers, Tigress, Ohio* and *Trippe,* sailed from Buffalo on June 13, but head winds baffled them, and it was only by the merest chance that they ever arrived safely at Presqu'isle five days later; for the new British commander, Captain Robert H. Barclay, with commendable promptness, had taken the Lake with a superior force shortly after his arrival at Amherstburg, and was cruising between Black Rock and Presqu'isle to intercept the expected reenforcement; but Perry, coasting the beach, slipped by the

enemy's vessels unseen in a fog, and on June 18 reached a safe anchorage.

The first and most serious obstacle that confronted the American commander now had been successfully overcome; his concentrated force lay within the bar at Presqu'isle. There remained still the task of pressing the completion and equipment of the two brigs begun by Chauncey the previous winter. These were sister ships, the *Lawrence* and the *Niagara*, of five hundred tons burthen, and carrying eighteen 32-pounder carronades and two long 12-pounder guns. By the 23d both had been rigged, and armed, and would have been ready for service had there been men enough to man them. But of seamen there were no more to be had. Chauncey himself was still very short of men, and at one time even hinted the necessity of laying up his own fleet on Lake Ontario to man that on the upper lake. But Perry was not to be discouraged. Seeing the difficulty of increasing his complements, he went so far as to offer to enter upon active operations with half the number of men which he and Chauncey had agreed upon as essential to success. The commodore naturally expressed surprise at this change in his subordinate's "sentiments," but added that "if Captain Perry can beat the enemy with .... that number, no one will feel more happy than myself." Of the *Lawrence's* nominal complement of one hundred and eighty, Perry actually had but one hundred and forty-two, of whom thirty were on the sick list; while in the squadron, instead of the required seven hundred and forty men, there were but four hundred and ninety on board. Of this number, nearly one hundred were received from the army only nine days before the battle.

Notwithstanding Perry's willingness to make the best of his difficulties, this state of affairs came near causing his withdrawal from the squadron; "a loss which, had it occurred, might have reversed the issues, for in few general actions has the personality of the commander counted for so much, after the battle joined." One of Chauncey's letters offended his young subordinate, who was only twenty-eight years of age, and, though amiable, naturally quick of temper. Under the first impulse of resentment, the latter applied to be removed from the station because of the receipt of this letter, "in every line of which is an insult." But, fortunately, it was impossible at that moment to

grant this request, and Perry eventually reaped the harvest which he had so well sown.

While the preparations were nearing completion at Presqu'isle, General Procter, commanding the British land forces, with the cooperation of a sufficient squadron, was planning expeditions from Malden against every place on the lake frontier except the very one to which military necessity and his orders bade him go. At the time of Perry's arrival at Erie, March 27, that port was utterly defenceless, and without arms or ammunition of any kind, although the keels of the brigs had already been laid and the gunboats would soon be nearing completion. A visit to Pittsburgh secured four small guns, some muskets, and some five hundred militia, and with this slender protection Perry pushed on the arduous work of building and equipping his squadron in what was virtually a wilderness—a wilderness abounding in ship-timber, but one to which mechanics and ship-wrights, and most of the materials and stores they needed, as well as the seamen to man the ships, had to be brought from the Atlantic seaboard under difficulties of transportation now hardly mentally pictured. Procter, however, bided his time, and, eager for action somewhere, directed his first efforts against Fort Meigs. For a week he besieged that post, May 1 to May 9, but without success. Then he bethought himself more seriously of the situation at Erie, and demanded reenforcements to attack the place. The advisability of this move was not denied, but the additional force requested was not forthcoming. The project against Erie was therefore abandoned, and the offensive transferred to Sandusky. Barclay was, however, directed to get under way with his fleet and cruise off Erie in order to retain the American vessels to port until the necessary assistance could be obtained. On the passage the British ships stopped at Long Point, on the Canadian shore directly opposite Erie, in the hope of finding additional seamen for their crews, and to embark a hundred soldiers to cooperate in the expedition. But the desired troops were refused, and Barclay found himself obliged to appear off Erie, on July 20, with his fleet most inadequately equipped, undermanned, and in want of everything. The loss of York in the spring, when all the ordnance, ammunition, and other stores intended for the service on Lake Erie were either destroyed or captured by the Americans, had been irreparable. Barclay's only

hope lay in completing a vessel called the *Detroit*, then on the stocks at Amherstburg, for which he had, with great difficulty, secured a collection of guns of various calibers from the ramparts of the fort. Thus equipped, she had to be manned; but no seamen were near at hand. As a last resort Barclay, at the last moment, was forced to make up a crew from a regiment of the garrison and from some available Canadians. Then, with the *Detroit* ready to sail, her commander had no alternative but to go out and fight. "So perfectly destitute of provisions was the port," wrote Barclay, "that there was not a day's flour in store, and the crews of the squadron under my command were on half allowance of many things; and when that was done, there was no more."

So great, in fact, were Barclay's own discouragements, that he allowed his great opportunity to escape him. For at the time of his appearance before Erie, on July 20, that port was so inadequately defended that the boats of his squadron might have made short work of the militia detailed for the protection of the vessels within the bar. But he merely made his presence known, cruised before the harbor, and then, on the 30th, disappeared, and was not seen again until the 4th of August. Once before fortune had smiled upon Oliver Hazard Perry, and now, as upon that occasion, that young officer was not found wanting. The harbor of Erie in which his fleet was assembled was an excellent one except for a bar at the entrance on which there was never more than seven feet of water. This natural barrier hitherto had prevented the enemy from getting in; since the completion of the brigs it as effectually prevented the American vessels from getting out. Perry's preparations for the passage had been completed days before. The minute the British fleet disappeared from view below the horizon everything was hurried forward. Five of the smaller vessels were ordered across the bar to positions covering the channel, and three long 12-pounders were hastily mounted on the beach abreast the shoal. The brigs were lightened of their guns, and their hulls so lifted upon floats, that these, when sunk, made fast, and pumped out, raised the vessels sufficiently to admit their being floated over the shallow channel. The weather, fortunately, was propitious, and the *Lawrence* was successfully carried outside, although she once grounded on the shoalest spot and had to be refloated. At 8 o'clock on the morning of

the 4th, she was fairly afloat, with her guns on board and just mounted, when the British reappeared. The *Niagara* immediately followed her sister ship into deep water, and then for the first time Barclay could not make an attack with any hope of success.

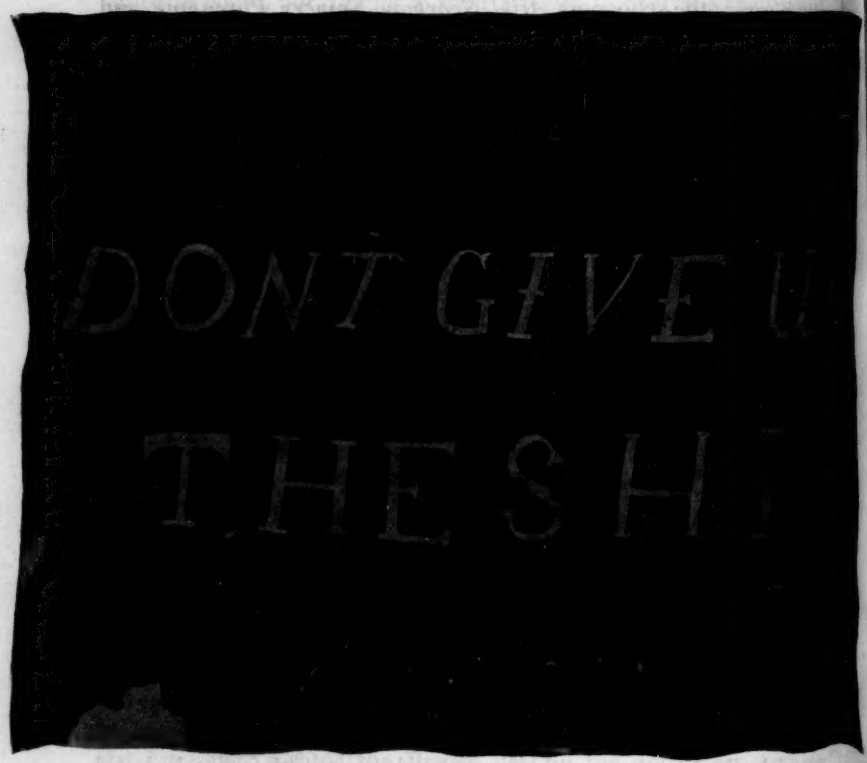
With Perry's entire force on the Lake, Barclay's only alternative was to seek the shelter of his batteries and await the completion of his most powerful ship, the *Detroit*. The Americans at once sailed in chase, but, failing in their attempt to overtake the enemy, returned to Erie for a fresh supply of provisions and stores for the army at Sandusky. While thus engaged, there came the welcome intelligence that Captain Jesse D. Elliott, an officer of reputation, with one hundred and two officers and men, was on his way to join the squadron. On the 10th they arrived, and two days later all was ready. The squadron got under way once more, and started out on what proved to be its final cruise, for the vessels did not return to Erie again until the close of the campaign when not a single enemy remained to oppose them upon the Lake. On August 25, Perry was off Malden, and again on the 1st of September, when he reconnoitred the British squadron near the harbor's mouth. But Barclay refused to be tempted. He was having his own troubles securing men for his ships, and was determined upon postponing action until the necessary reenforcements reached him, or until the shortage of provisions, already staring him in the face, compelled him to force an action in order to reopen his communications with Long Point, from which all stores now had to be transported to Malden by water. Perry, therefore, established his headquarters at Put-in Bay, in the Bass Islands, some thirty miles southeast of Malden, whence he could easily watch his enemy and await the moment when Barclay should attempt to reach his base of supplies.

At daylight on September 10, the lookout at the masthead of the *Lawrence* sighted the British fleet in the northwest, coming down before a fair wind. Perry at once got under way, and began to beat out of the bay. The breeze, however, soon shifted to southeast, and there steadied, which not only enabled the Americans to quit the harbor, but gave them the weather position, an advantage which they maintained throughout the day. The British force consisted of six vessels—the *Detroit*, Barclay's flagship, carrying nineteen guns; the *Queen Charlotte*, of seventeen guns commanded by Captain Finnis; the *Lady Prevost* of thirteen

guns; the *Hunter* of ten; the *Little Belt* carrying three; and the *Chippewa* carrying one gun—in all, sixty-three guns, and probably about four hundred and forty men. The American squadron on the other hand numbered nine vessels—the *Lawrence*, Perry's own brig, nearly as large as the *Detroit*, and carrying twenty guns; the *Niagara*, commanded by Captain Elliot, of the same tonnage, and with the same armament; the *Caledonia*, of three guns; the schooners *Ariel*, *Scorpion*, *Somers*, *Porcupine*, and *Tigress*, carrying ten guns; and the sloop *Trippe*, with one gun—in all, fifty-four guns, with an effective crew slightly smaller than that of the British. In number of guns the enemy were superior to the Americans. But in other respects—in ships, in tonnage, and in weight of metal thrown in a broadside, whether at long range or at close quarters—Perry had a most decided advantage. The Americans had thirty-nine 32-pound carronades; the British not a gun of that weight, and only fifteen 24-pound carronades. The lightest guns on the American vessels were eight long 12-pounders, while twenty-four of the British guns were only 9-pound shot, or less. The American broadside at long range was two hundred and eighty-eight pounds of metal; the British threw but one hundred and ninety-five pounds; while at close range the American superiority was as nine hundred pounds against four hundred and sixty.

Of this advantage Perry made full use. Leading the van in the *Lawrence*, with the blue flag inscribed "DON'T GIVE UP THE SHIP!" at her masthead, and supported by two gun-boats on her weather bow, he bore down before the light breeze and met the enemy's fire shortly before noon. Ten minutes later the Americans began to reply, but their shots all fell short, while those of the British were much more destructive than had been anticipated. Perry, therefore, made more sail upon the *Lawrence*, and passed word by hail to the vessels astern to close up and for each vessel to bring her designated opponent into close action. Gradually the distance between the opposing lines shortened until the American flagship had worked her way to within canister range, about two hundred and fifty yards. The range was still greater than desirable for carronades, but Perry had stood his opponent's raking fire as long as possible, and besides the *Lawrence* had already suffered so severely in her rigging, that she was fast becoming unmanageable. The battle was thus joined by the Ameri-

can flagship, supported by the long guns of the *Scorpion* and *Ariel* ahead, and the *Caledonia* astern. The *Niagara,* however, failed to come up, and her immediate opponent, the *Queen Charlotte,* was therefore left free to quit her position in line, range ahead of the *Hunter,* and bring her battery to bear upon the *Lawrence,* which for some time had been closely engaged with the



British flagship. In this position the action at the head of the line was fought most desperately until half past two. On each side the large ships were the targets for all guns, and suffered greatly. The *Queen Charlotte* was hulled repeatedly. Both flagships were well-nigh disabled; the *Detroit,* raked by the fire of the gun-boats and hulled by that of the *Lawrence,* was terribly shattered, while the *Lawrence* herself was reduced to little more than a wreck. Not a brace, not a bowline, not a gun on her engaged side re-

mained on the American ship; eighty-three of her men, over half of her total complement, had fallen; her hull was riddled and splintered by shot which passed through from side to side, killing the wounded in the cockpit as they lay on the surgeon's table. With only one gun left, she was a beaten ship, although her colors still floated in the breeze. But the courage and resolution of Perry never faltered. Finding that the *Lawrence* could no longer annoy the enemy, he himself, with the assistance of the purser and chaplain, gave the *Detroit* one more shot from the last effective piece, and, leaping into a small boat, was rowed to the *Niagara,* which for some reason never known, had carefully remained out of reach of harm with four of the gun-boats, desultorily firing her two long-range guns at the enemy's vessels. To the *Niagara,* therefore, Perry transferred his flag, and he had the satisfaction of knowing that he had reached a fresh ship while the colors of the one he had left were still up.

All sail was at once made upon the new flagship, and, with the schooners lagging in the rear, Perry bore down to break the enemy's line. The outcome of the action was now no longer in doubt. As the *Niagara* came within range, the *Detroit* tried to wear, to avoid being raked as well as to try to bring her unengaged battery into action. But in executing this manœuver she fell foul of the *Queen Charlotte* which was ranging ahead on her lee quarter, and before the two could be got free Perry broke through. Firing his port guns into the *Chippewa, Lady Prevost,* and *Little Belt,* and his starboard guns into the *Detroit, Queen Charlotte,* and *Hunter,* he came on, delivering a murderous raking fire on both sides. One more attempt was made by the British to bring their batteries to bear, but their valor was in vain. The end was inevitable. With the ships lying completely unmanageable, every brace shot away, and spars down or badly wounded, their guns disabled, and the American vessels raking them ahead and astern, no alternative was left but surrender.

Thus was the campaign of Lake Erie fought and won. The scale and theater of its operations was small and confined indeed; but its military and political consequences were immense. It decided the military situation in the Northwest once and for all; it gave the Americans the supremacy on Lake Erie; it compelled the enemy to evacuate Detroit and the Michigan territory; it shook the Indians' allegiance to the British cause and henceforth freed

the frontier from the terror of savage massacres. "But the effect on the people—what it soon became the custom to call the moral consequences—outdid anything yet experienced. The almost unbroken series of naval victories on the sea had begun to pall. The charm of British invincibility was broken by Hull, Decatur, Bainbridge, and Burrows. Ship to ship, man to man, gun to gun, it had been proved over and over again that Great Britain was no match for America. But, till Perry met Barclay on Lake Erie, no fleet bearing the flag of the United States had ever encountered a fleet bearing the flag of England. In Perry, therefore, the people found a new sort of hero, a young Nelson, and, carried away by his youth, by the energy with which he built and manned his fleet, by the courage with which he bore the brunt of the fight, by the dramatic episode of the open boat, and by the skill with which, when all seemed lost by the mismanagement of Elliott, he brought up the *Niagara* and won the day, the people went wild with joy and in their ecstasy made him the hero of the war. All over the country bells were rung, cannon fired, towns and cities illuminated in his honor, and swords without number voted him. Albany gave him the freedom of the city, a sword, and a fine reception. Poughkeepsie was illuminated. Philadelphia took a day to rejoice and a night to illuminate. New York and Baltimore did the same. The people of Boston, in mass-meeting assembled, voted a sword. The *Constitution* honored him with a salute. Both parties claimed him as their own. He became the toast of the hour at innumerable Democratic festivals held to celebrated the 'triumph of the American arms over their enemies,' and the chief theme of scores of naval songs, odes, verses, and impromptu lines. He deserved it all; for if ever a battle was won by the obstinacy and courage of one man, it was the Battle of Lake Erie." *

* McMaster: History of the People of the United States, Vol. 4, p. 38.

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THE NAVY AND THE PANAMA CANAL.

By CAPTAIN HARRY S. KNAPP, U. S. Navy.

The completion of the Panama Canal is so nearly at hand that the time has seemed appropriate to the Board of Control to publish in the PROCEEDINGS a discussion of the effect of the canal upon the navy. In responding to their invitation to submit a paper on this subject the writer wishes at the outset to make plain that what follows represents his personal conclusions, and that he neither desires nor is authorized to speak for anybody but himself.

Because it has the widest appeal the question of how the canal will affect the strength of the navy will be considered first and at most length. To those outside of professional circles it has a more direct and personal application than any other, because upon the answer will depend the appropriations that the taxpayer must provide. The canal has been an expensive undertaking for the United States, and the people of the country, in thinking of its bearing upon the navy, naturally anticipate that its completion may considerably modify the appropriations for the upkeep of the naval establishment. Everybody is familiar in a general way with the shortening of sea routes via the Panama Canal from our Atlantic to our Pacific coast; for instance, that the direct distance from New York or Philadelphia to San Francisco is reduced from about 13,000 miles via Magellan to about 5000 miles via Panama, or that the distance from New Orleans to San Francisco is about 9000 miles less via the canal than via Magellan. From such general and obvious knowledge it is an easy step to the conclusion that the strength of the navy with the canal may be much less than it would necessarily be without the canal; or, what amounts to the same thing, that the appropriations for the navy may be greatly reduced as soon as the canal is opened. Twice recently

within a week the writer has heard members of Congress refer to this very matter, one of them saying, in effect, that the canal would increase the effectiveness of the navy two- or three-fold, while the other thought its effectiveness would be doubled. The writer, while prepared to admit that these remarks were rather an after-dinner *façon de parler* than the expression of a deliberately formed opinion, yet believes they indicate a somewhat general impression that careful study of the situation will not justify.

A prerequisite to the formation of any intelligent conclusion on this question is an understanding of the conditions that govern the strength of the navy. The ultimate, dynamic, use of the navy is to beat the enemy in war; the every-day political use of the navy in peace is to avert war by reason of its existence ready for war. Neither purpose will be served unless the navy be adequately strong in material and personnel, and unless the personnel be trained and efficient; the navy itself is responsible for trained efficiency, but the country at large, through Congress, is responsible that adequate strength be provided.

Wars do not merely happen; they usually result from the clash of some definite policies. In an attempt to fix the strength of our navy the national policies of our government that affect other countries are a prime factor to be considered. The United States has the following definite policies in its external relations: 1st, the avoidance of entangling alliances; 2d, the Monroe Doctrine; 3d, the Open Door in the Far East; 4th, Asiatic exclusion; 5th, the control and protection of the Panama Canal itself. Where any of these policies affect adversely the interests of other nations there is the possibility of friction, and where friction arises there is always the possibility of war.

The first of the policies mentioned above may be dismissed with a word, for it is distinctly one of abstention, and so is not apt to be the cause of diverse interests. Its effect is, however, that we must play a lone hand, and that is not without a bearing on the strength of the navy. The second policy was recognized in a manner by England in the Clayton-Bulwer treaty of 1850, and to a greater degree in the Hay-Pauncefote treaty of 1901. But other nations do not accept it as international law, and it is not infrequently the subject of unfriendly comment. The Monroe Doctrine may be the occasion of friction, and so of war, with European nations, and there is a possibility that it may be with

Japan, or at a later day with China. The relation of the Monroe Doctrine to the navy was pointedly indicated by Mr. Secretary Meyer, when he said in effect, for his words are not before the writer, that the Monroe Doctrine is just as strong as the navy, and no stronger. The third policy is one that may cause friction with both European and Asiatic nations. The fourth concerns our relations with Asiatic nations only. The fifth policy is a result of a duty we have assumed single-handed for manifest reasons of advantage, and we consulted no nation about it except Great Britain. It has a very direct bearing upon the strength of the navy, upon which it throws an added responsibility.

The extension of our foreign trade that is now being so urgently advocated in connection with the change of our tariff laws cannot be placed, perhaps, under the same head as the policies just mentioned. But foreign trade certainly does involve relations with foreign nations; and, as a matter of fact, commercial and trade rivalries are most fruitful causes of misunderstanding between nations.

What has just been said does not exhaust all sources of possible wars by any means, as it does not exhaust all of our external relations. Enough has been said, however, to show reasons why war is not an improbability—certainly it is a possibility—with nations in Europe and Asia. European nations will hardly attack us in force in the Pacific, nor will any nation fronting on the Pacific be apt to attack us in force in the Atlantic. We have, therefore, to anticipate the possibility of war in the Atlantic with a European nation, and in the Pacific with an Asiatic nation.

This leads us to the formulation of a policy for the strength of the navy. It should be strong enough to safeguard our interests and meet any probable attack in either ocean and not leave our interests unguarded in the other. In explanation of the last clause it may be said that a full consideration of the subject should not stop short of the possibility of a simultaneous attack in both oceans, however improbable; a war with allied nations in the Atlantic and Pacific is not impossible. It is especially the duty of men in the military branches of the government to have their eyes open to every contingency.

In considering possible antagonists in the Atlantic Great Britain may be eliminated from consideration. In the first place it would take us many years to catch up with her in material

strength if we tried, and would entail an enormous expense; in the second, war would be a blow to her commercial interests and interests of supply that she can ill afford to suffer; and, in the third, we have a hostage in Canada worth many battleships. There are, moreover, powerful interests of a more sentimental nature that are yet very real. No such strong reasons exist for eliminating any other European nation from the list of possible antagonists and the formula therefore becomes, in its final and definite statement, that our navy should be strong enough to meet in the Atlantic the maritime nation of Europe next strongest to Great Britain, and in the Pacific the strongest nation in that ocean.

As affecting the strength of the navy it is well to keep in mind also the position of the United States in the two oceans. In the Atlantic, aside from the maintenance of the Monroe Doctrine, we have a great material interest in Porto Rico, which is our own territory; and toward Cuba and Panama we have a duty in the protection of their independence. Then there is the canal itself. All of these interests are comparatively near to us, and very much nearer than is any European adversary. In the Pacific we are in a very different case. There we have Alaska, the Hawaiian Islands, Guam, the Philippines, and Tutuila, the nearest 2000 miles and the most distant 7000 miles from our coast, and some much nearer possible adversaries in that ocean than ourselves. The distance of our outlying Atlantic interests has vastly less bearing on the strength of our fleet in that ocean than has the distance of our outlying Pacific interests on the strength of the fleet in the Pacific.

If the Atlantic and Pacific were closed oceans the formula reached above for the strength of the navy would mean that in each there should be maintained a force (that may be called the Standard Atlantic Fleet and the Standard Pacific Fleet, for brevity) sufficient for the duty in that ocean, which is the Two-Ocean Standard, pure and simple.

Neither here nor elsewhere in this paper will a concrete estimate be undertaken of the strength in numbers of ships of the "standard" fleets. Such an estimate is not reached by a simple matching of ship by ship, but is influenced also by such considerations as the probable situation of the theater of war, the possibility that the assumed antagonist may not be able to have his entire

strength present in that theater for political or other reasons, and the morale of the antagonist. This may not impossibly result in the conclusion that our own necessary strength *in ships* is less than that of some possible antagonists and greater than that of others. For the present purpose no such concrete estimate is necessary and it is enough to say that the strength should be "sufficient for the duty."

Without the canal the requirements are practically the same as if the Atlantic and Pacific were closed oceans. For, though the possibility exists of reinforcement in one ocean from the other, yet the long distance to be traversed by the reinforcement by whatever route, the difficulties about fueling en route, and the danger, especially to a force coming from the Pacific, of finding the enemy between the reinforcement and the body it is attempting to join, all militate so greatly against a successful issue that it would be imprudent to count upon it.

With the canal in operation, however, a different situation arises. The route of the reinforcements will be shortened from 8000 to 10,000 miles by the canal, and that route will lie on interior lines. Fuel can be taken at stations under our own flag, separated by distances less than those representing the sea endurance of the fleet; the embarrassment arising from the necessity of avoiding any semblance of violating neutrality in fueling will thus be avoided. Junction is possible from 40 to 60 days sooner, and the enemy need not be passed to effect it. Put in another way: Guantanamo is at practically the same distance from the English Channel that it is from San Francisco via the canal; or again, the nearest Asiatic port to Honolulu is only about 1250 miles nearer than Panama, but is about 8700 miles nearer to Honolulu than our nearest Caribbean port by way of Magellan. In the face of such facts it would be difficult to maintain that the canal will have no effect on the strength of the navy, for that would be tantamount to the claim that the canal has no military value to the United States.

On the other hand, the claim that the canal will double the effectiveness of the navy or more is a great exaggeration. Though such statements probably result from loose use of language rather than a careful study of the situation, they are dangerous, for they are apt to be taken literally by the layman, and the navy cannot afford to have such an impression gain ground. To show their

fallacy it is only necessary to consider the matter of distances. It is quite true that the canal will enable the fleet to be transferred from one ocean to the other in a few hours, but that is only the beginning of the problem. The added strength that the canal will give to the navy must be measured by the facility the canal affords in enabling reinforcements to arrive *in time to be of use tactically;* that is, as a part of the entire force in battle with the enemy. The canal will be of little use if the reinforcements arrive so late that the battle has already been won by the enemy. The Atlantic terminal is about 700 miles from Guantanamo, 1200 miles from the most distant part of the Caribbean, and 2000 miles from New York, no inconsiderable distances in themselves. On the Pacific side the condition is very much less favorable, for the Pacific terminal is about 3250 miles from San Francisco, 4700 from Honolulu, 8000 from Guam, and 9350 from Manila. Merely to be able to get the fleet rapidly from one ocean to another is a great gain, a very great gain; but it is not by any means the whole problem. Allowing the fleet an average speed of 12 knots from departure to destination, which is high, considering the time necessary to coal and effect repairs and the necessity that all the fighting components arrive together and *ready for action,* this means that, from the time of leaving the canal until it arrived where it would probably be needed, the shortest interval is about 58 hours to Guantanamo, and the longest is about 33 days to Manila, during which the enemy will not have been idle. The canal will be a great military asset in war, and an equally great one in anticipation of war; but it is quite beside the mark to say it will double the effectiveness of the navy, or do anything approaching that.

The truth, as usual, lies between these two extreme views just examined, and the writer believes that the former is much nearer the truth than the latter. By its very nature the problem of determining just what will be the effect of the canal upon the strength of the navy cannot be mathematically demonstrated. The solution is largely one of opinion, and will be modified as greater or less weight is given to the several considerations on which it is based. If the general formula advanced above for fixing the strength of the navy be accepted, then manifestly, canal or no canal, the minimum permissible strength of the navy is that which will enable us to meet, with our entire force, our

strongest probable enemy, wherever situated. Under the same conditions the maximum strength that can be claimed as necessary is the sum of that of the Standard Atlantic Fleet plus that of the Standard Pacific Fleet (Great Britain being excluded for reasons above given). This amounts to saying that the maximum strength that can be claimed as necessary is that which will enable us to conduct a war with prospect of success in both oceans at once, which is the Two-Ocean Standard again. If the possible antagonists in the two oceans, in relation to whom our formula for strength is founded, were equally strong, our minimum permissible navy would be half as strong as the maximum navy that will ever be necessary. They are not equally strong, however, and our Standard Atlantic Fleet should now, and the condition is probably permanent, be stronger than the Standard Pacific Fleet need be. The Standard Atlantic Fleet, therefore, is the measure of our minimum permissible strength; and, to avoid any misunderstanding, the words "minimum permissible strength" are used in the narrow sense of indicating the very least strength that can logically be believed allowable by anybody who believes in a navy at all for well-founded reasons. The quoted words do not represent the writer's views of what our minimum naval strength should be.

Our total naval strength at this minute is not equal to that of what is called above the Standard Atlantic Fleet. Hence the completion of the canal should have no immediate effect upon our building. It remains to find an answer to the question: What effect will it have upon our building policy for the future?

The writer's personal opinion is that, when the canal is finished, our policy should be to have eventually, and as soon as possible, a total strength not less than that of the Standard Atlantic Fleet plus three-quarters that of the Standard Pacific Fleet. These so-called "standard" fleets are not fixed quantities, but will vary from year to year as foreign nations increase their own naval strength. The policy itself can, however, be fixed, and some policy should be established.

The reasons that have appealed to the writer in reaching this conclusion are as follows:

(a) With no canal our total strength should be the sum of both the Standard Atlantic Fleet and the Standard Pacific Fleet.

(b) The canal so greatly shortens distances between the two

oceans that some reduction of strength below that of (a) is justifiable when it shall be finished, in view of the great financial burden imposed by a great navy, and the rather remote possibility of simultaneous war in both oceans.

(c) This reduction should not be sufficient to leave the nation in a hopeless case in either ocean if war broke out there while war was being waged in the other.

(d) As the strength of the Standard Atlantic Fleet must be maintained in any event, the Pacific Fleet is the one in which to make the reduction in strength.

(e) Our interests are so great, and are scattered over such immense distances in the Pacific, that anything less than three-quarters of the Standard Pacific Fleet would make even a defensive war in that ocean hopeless.

(f) With three-quarters of the Standard Pacific Fleet a defensive war, a containing war so to speak, would not be hopeless while waging a war on equal terms in the Atlantic.

(g) If there were no prospect of war in the Pacific at a time when engaged in war in the Atlantic, then one-half of the Standard Pacific Fleet, and perhaps less, would suffice to guard our interests in the Pacific, leaving the rest of the fleet in that ocean free to reinforce the Atlantic Fleet and give in the Atlantic a marked superiority of force.

(h) If at war in the Pacific with no prospect of war in the Atlantic, a great superiority of force could be maintained in the Pacific that would be the more valuable, owing to the distances over which the navy would have to operate in that ocean.

The composition of the fleet will be little affected by the existence of the finished canal. All classes of fighting ships will be as much needed after the canal as before, and their numbers and proportions deemed requisite for the duty in either ocean will be necessary, canal or no canal. It is not improbable that the defense of the canal itself may demand a limited number of certain classes of vessels that would not otherwise be necessary. But in its large aspect the composition of the fighting fleet can hardly be affected by the completion of the canal. Even in the matter of auxiliaries the same thing appears to be true. If the navy depended upon its own auxiliaries for the transfer of supplies and fuel from one ocean to the other, the canal would

naturally serve to diminish the number of supply and fuel ships; but such cargoes are practically all sent by contract. Other auxiliaries are based in number on the fighting ships they have to serve, and distance has little to do with the question. Speaking in a broad way, then, the existence of the canal will have no effect on the composition of the fleet.

It is more than probable that the completion of the canal will effect some changes in the disposition of the fleet in time of peace. It has already been pointed out that the navy is not now as strong as is theoretically necessary in the Atlantic alone; so that for a considerable time to come, whatever building program may be adopted, it will be necessary to concentrate our entire fighting fleet in time of war, trusting to Providence that the part sent to the threatened ocean will not be needed during the war in the ocean from which it is withdrawn. In effecting this concentration the canal will be a very great military advantage to us. In time of peace, however, the completion of the canal will enable some changes to be made in the present disposition of the fleet. The disposition now, while dictated by reasons of convenience under present-day conditions, is yet not very logical considered in the light of all-round preparedness for war. A very possible outcome will be the maintenance of a force of fixed strength in each ocean, with a shifting squadron that will go first into one and then into the other. This can be so managed as to keep in both oceans a force better balanced in all its components of fighting strength than is now the case with either. There will be other advantages also, one being the appearance on the Pacific coast of parts of the navy that cannot now be seen there. The people on the Pacific coast are as vitally interested in the navy as are those in the East; yet they habitually see the least powerful and least modern of our ships. It is natural and, indeed, commendable, that they should wish to have in their own waters at one time or another the flower of the navy. The completion of the canal will enable this to be done; and it will, further, be good policy for the navy to do it, and so stimulate the friendly interest in the navy that is always in evidence on the Pacific coast.

Another advantage that will accrue in connection with the transfer of ships from one ocean to another is the possibility of making between our own ports, and without taxing the hospitality

of foreign nations, the long voyages in fleet that we believe in our service to be so advantageous as a means of fleet discipline and fleet preparedness. The entire battle fleet could easily go from New York to Seattle, stay ten days at San Francisco and ten in Puget Sound, and be back in New York in a little more than three months. As a long-distance cruise this would have many advantages over a cruise to Europe and back, not the least of which would be the experience gained in logistics over a route that the fleet may have to make some day in one direction or the other when the errand is not peaceful.

The completion of the canal will be advantageous to the navy in still another way connected with the disposition of the ships of the fleet. Corinto, Nicaragua, is less than 100 miles further distant from New York via Panama than it is from San Francisco. All the Pacific coast of Central America outside of Mexico is 1000 miles or more nearer Panama than it is to San Francisco. It will therefore be possible generally to send ships more quickly from the Atlantic to the Pacific coast of Central America in times of disturbance there than it will be to send them from San Francisco.

The preponderance of our naval strength will probably continue to be in the future, as it has been in the past, habitually kept in the Atlantic. That ocean is the better one for the upkeep, drill and administration of the battle fleet for many reasons. But the canal will permit of many changes of disposition, some of them permanent and some temporary, that will be advantageous and that are impracticable under present conditions.

The completion of the canal should serve to bring home to every one the importance of our naval bases in the West Indies and the Pacific. That their importance has not been adequately realized is evidenced by the lack of funds provided to put them in an efficient condition. The Monroe Doctrine was an old story before the war of 1898; but few people realized that it extended our military frontier beyond the Atlantic and Gulf coasts, for it is a mental conception and not a tangible thing appealing to the senses. After 1898 and the acquisition of Porto Rico there was a visible projection of our frontier into the Caribbean; and after the Hay-Pauncefote treaty in 1901, which gave the United States undivided responsibility for the canal, another visible and

material interest appeared still further to the front. It has always been clear to the naval mind that our military frontier extends far beyond our continental borders, and now, irrespective of the Monroe Doctrine, it extends from the Atlantic coast around Porto Rico to the canal; and it has been equally clear that, for the security of that frontier, a naval base somewhere on the outer edge of the Caribbean is a necessity. After careful consideration Guantanamo was selected as the site for such a base as being the suitable harbor situated furthest to the front on the edge of the Caribbean. Congress has not yet recognized its appreciation of the necessity for Guantanamo by the provision of an adequate program for its defense and equipment, though there are some signs of such an appreciation. Nor do the people of some of the gulf states realize that the frontier has advanced more than a thousand miles from their coast, and that the New Orleans and Pensacola naval stations no longer serve any useful military purpose, if one may judge by their arguments against the action of the Navy Department in closing them during the last administration. When the canal becomes a great utility in regular operation instead of an interesting engineering work, when trade has settled into the new routes the canal will make possible and when business men have occasion to think of it daily as a vital link in their transportation problems, a juster appreciation will arise of the necessity of a naval base at Guantanamo for the protection of the canal and of the trade routes converging toward it, as well as for the maintenance of our general interests in the Caribbean, that will doubtless find expression in a complete scheme for its defense and equipment.

If, as it almost surely will, the canal serves to place in the Pacific Ocean, even for a part of the time only, a greater force and one of larger ships than is now kept there, the question of bases in that ocean must be considered. In the Pacific, excepting our limited plant in the Philippines, there are three bases—Mare Island, Bremerton, and Pearl Harbor. To care for any considerable force in peace, and, what is more important, to care for it in war, these are all too few. Pearl Harbor is in the making, and Bremerton is not yet a first-class base. San Francisco Bay is the place above all others on our Pacific continental coast that is suited for a naval base by reason of its strategic situation geographically and the advantages attending the proximity of a large city. But the Mare Island Navy Yard is impossibly situated for

this purpose. It has neither the area nor the depth of water needed for modern capital ships and its distance from San Francisco and lack of a railway connection are handicaps in the supply of labor and in the economical handling of freight and building supplies. At the present time the available depth is 22 feet at mean lower low water, and the channels constantly and rapidly silt up. It is even difficult to keep the entrance to the new dry-dock deep enough for safe docking of ships that can enter it. The adopted departmental policy is to have 40 feet depth from the sea to our navy yards, and that depth of channel is being urged at our important commercial ports in the interests of commerce. To all except those who will not see it has been increasingly evident during the last ten years that the Mare Island Navy Yard is doomed for the service of modern capital ships, and it is equally evident that a new location, somewhere in San Francisco Bay, on deep water near the city, must eventually be provided for their docking and repair. If the people of California desire and expect to see any considerable part of our modern fleet habitually visiting in their waters after the canal is finished, they cannot too soon bestir themselves to provide in the deep water of San Francisco Bay the naval facilities that are required for the supply, upkeep and repair of modern capital ships. Mare Island does not afford them, for the simple reason that recent capital ships cannot safely go there, if for no other. Men cannot drive rivets on a ship 20 to 30 miles away. The completion of the canal should help to force this conclusion home if the people of California are not prepared to accept it now.

Of Pearl Harbor and Bremerton there is less occasion to speak in this connection. Congress is treating Pearl Harbor in a liberal spirit, and the facilities at Bremerton are gradually increasing. The development of both should go on to provide for the increased naval shipping that may naturally be expected to follow the completion of the canal; but, above all, to provide for the greatly increased demand upon them in the event of a war in the Pacific.

The consideration that perhaps comes most naturally to mind in connection with the canal is the immense shortening of distances effected by it in most cases between points in the Atlantic and Pacific. This consideration was, of course, the reason for build-

ing it. What may be termed the commercial routes from New York to Hong Kong, those that take in ports of call, are practically the same length via Panama and Suez, the difference between them being less than 20 miles in favor of Suez; but the Panama route is the shorter from New York to Shanghai and the ports of Japan. From New York to Manila the Panama route is shorter than that by Suez unless the former go by way of Honolulu and Yokohama. The further east the point in the Pacific, the greater the gain in distance to New York by the Panama route. Valparaiso is 3750 miles nearer New York via Panama than via Magellan. Speaking generally, the distance is shortened via the canal from New York to any point in the Pacific inside of a line drawn from Magellan Strait, through Australia and the Philippines, to Hong Kong. As affecting naval movements this means more than time and fuel saved, though both economies are of prime importance. It means the possibility of sending ships from the Atlantic to almost any place where they will be needed in the Pacific by a route that has fuel stations under our flag along the entire distance, no two of which are further apart than the fuel endurance of our capital ships. This is an enormous advantage, for the problem of fueling our naval ships in time of war on a passage from the Pacific to the Atlantic, or vice versa, would be a staggering one by either the Suez or Magellan route, and the attitude of neutrals might make it almost an unsolvable one. The canal will eliminate the question of neutrality altogether, and for that reason alone it is of incalculable benefit to the navy.

The question of economy is, however, one not to be ignored. Between New York and San Francisco, in either direction, Panama and Guantanamo would probably be ports of call for a fleet. A study of the saving of time, fuel and money effected by sending a fleet between Panama and Guantanamo through the canal instead of through Magellan gives some astonishing results. Such a study has been made, based on the movement of 25 capital ships with attendant cruisers, destroyers and auxiliaries. It is too long to give more than the results, but they are sufficiently interesting.

The time saved under the assumptions is about 60 days. This could be considerably shortened by increasing the assumed sea speed, or decreasing the days at anchor for coaling, repairs,

and recuperation of the personnel, but at the expense of fuel burned, with the attendant cost and necessity of fueling oftener. The route via Magellan that the fleet would follow between Guantanamo and Panama requires nearly 900 actual steaming hours at 12 knots, or 37 days. This makes no allowance for necessary time to refuel and repair, so that 60 days is not an unreasonable gain in time to allow in favor of the canal, in view of the fact that refueling on the Magellan route would have to be carried on at places outside the territorial limits of neutrals, and often under disadvantageous circumstances. This might be time enough to enable the enemy to finish the campaign in his favor, not to speak of the harassment of the personnel while making the long sea voyage via Magellan, during which every man would know that he and his ship were needed every moment of the time, with the prospect that the fleet would not arrive after all in time to effect its purpose.

The saving in coal is about 290,000 tons, and in fuel oil about 54,000 tons. At the present market values of these fuels taken for the conditions, this means a money saving of nearly $3,000,000. Not to overestimate this saving, and assuming that an oversupply of 20 per cent has been allowed, the saving in coal would still be 240,000 tons, in oil 45,000 tons, and in money $2,500,000.

The gain in time is the all-important economy, but the saving in money is itself important. In view of our lack of a merchant marine, however, the simplification in the supply of fuel via the canal is of vastly greater moment than the money saving. The United States can furnish whatever money the circumstances of war may demand, but it cannot build over-night a merchant marine for the service of the fleet. This subject could be greatly elaborated, but enough has been said to show what a valuable military asset the canal is in its bearing on fleet logistics.

Simply for the ordinary service of the fleet in time of peace the canal will effect very large savings to the naval appropriations. A fair average price for eastern coal of a kind fit for naval use is $8.45 per ton at San Francisco, Puget Sound and Honolulu. While no exact prediction can be made, competent authorities believe that, when the canal is in operation, the price at which eastern coals can be laid down at these places will be not more than $6.20 per ton. Taking as a basis the amount of coal on naval account sent to the Pocific in the last fiscal year, 160,000

tons, the saving amounts to $360,000. Nor does the advantage end there; a collier can take a cargo via the canal to the Pacific coast, discharge and be back at Norfolk in the time she would take to make the voyage out via Magellan. This roughly divides by two the tonnage necessary for any given supply of coal at those ports. In time of war in the Pacific, this will be of inestimable advantage, considering our woful lack of a merchant marine. With respect to other bulky naval supplies, like provisions, the same thing does not hold true, for they can be delivered equally well and at little difference in cost on either coast from their points of origin. Even ammunition and guns, which are practically all manufactured in the east, would very probably be sent by rail to the Pacific in order to save time, though the expense would be greater. But with oil fuel, again, the advantage to the navy is apparent, and this time the gain is in movement toward the Atlantic. In the last few months the price of oil has markedly increased. California produces more oil than any other state and its price is lower than eastern oils. This fact, in addition to the important fact that a large oil-producing area has been set aside for naval purposes in California, points to the possibility that the navy may soon be using California oil in the Atlantic, which would hardly be possible without the canal. The demand for oil increases every day and many of the older wells are falling off in production; the navy may not improbably have great occasion in the years to come to congratulate itself that the canal will make the Pacific coast fields available.

Modifications of trade routes that will follow the completion of the canal are sure eventually to cause a reduction in freight rates, and so act as a stimulus to trade. The increased trade will, in turn, demand a greater tonnage, though this demand will be partially met at first by the ability of the same amount of shipping to provide for a greater trade because of the shortened distances via the canal. Still it can hardly be doubted that the opening of the canal will create a demand in time for an amount of shipping considerably greater than exists now in order to provide for the increased trade. The opinion has been advanced that the United States merchant marine will be greatly stimulated by the operation of these causes. The navy earnestly hopes that this may be true, for a large merchant marine is a necessity for a strong

navy only in a less degree than the auxiliary ships especially designed for its service; and anything whatever that can properly be done to increase the merchant marine should have the active support of the navy. In so far as the coasting trade is concerned there seems to be good reason to expect an increase of United States shipping, for that trade is certain to grow rapidly upon the opening of the canal, and foreigners cannot take any part in it. Moreover, the exemption of this class of shipping from the payment of canal tolls will virtually be a subsidy. Already some ships have been built for this trade in anticipation of the completion of the canal, and others are being built. But the writer has been unable to convince himself that the opening of the canal will alone serve to draw American capital into a form of investment from which it has persistently kept aloof, and under present conditions and laws he anticipates little or no resultant increase in that part of the merchant marine of the United States engaged in foreign trade. Without any close examination of the reason why, it seems to be a fact that Americans either cannot or else do not care to compete with other maritime nations in the sea carriage of foreign trade, and it is not apparent that the opening of the canal will by itself change that condition. That we should have a flourishing merchant marine is a matter of such vital interest to the navy that it will anticipate with satisfaction the increase of shipping engaged in coastwise trade due to the opening of the canal; and, as remarked above, the navy should exert its influence in favor of every proper measure tending to put American ships on the ocean in the foreign trade.

However interesting and profitable it may be to dwell upon the military advantages to the United States attending the opening of the canal, that feature is not the most vital one to the navy. The canal puts an added and very great responsibility upon the navy, and this fact is one that the navy and its friends must always keep in mind.

The canal is being built, and it will be operated and controlled, solely by the United States government. The protection of the canal, therefore, falls solely upon the United States. Moreover, in the Hay-Pauncefote treaty of 1901, the neutralization rules are embodied in Article 3, in which the language is: "The United States adopts, as the basis of the neutralization of such ship canal,

the following rules. . . ." We are, therefore, the sole guarantors of the neutralization of the canal. Again Article 1 of the treaty of November 18, 1903, with Panama reads: "The United States guarantees and will maintain the independence of the Republic of Panama." Finally, the United States trade passing through the canal will be very great. Here are new and great responsibilities, all flowing from the canal, and all dependent upon the navy for their realization. The navy is the outer line of defense of the canal as it is of the country. The inner line of defense of the canal resides in the fortifications and garrison at the canal itself. If our navy is driven from the sea and made negligible, an enemy with a great army can undertake with impunity the transportation of the troops necessary to overcome the inner line of defense and complete the victory begun on the ocean. The task may not be easy for him, but its possibility must be conceded if the sea is closed to us and open to the enemy. The only possible and final assurance of safety for the canal is in a navy strong enough to meet the enemy, beat him, and prevent him from ever getting near it. The following words, quoted from Admiral Mahan, indicate the alternative: "Permanent [naval] inferiority means inevitably ultimate defeat, which fortifications can only delay." And a few lines later he uses these words: "If the United States desires peace with security, it must have a navy second to none but that of Great Britain; to rival which is inexpedient, because for many reasons unnecessary."

The United States is not a military nation. There is little consideration and less understanding among the people at large of military matters. The government has no defined military policy, using "military" in its wide sense, and it has no defined naval policy. By this is meant that there is no soberly thought-out relation between our military strength and our situation in the world—between our declared external political policies and the only means yet found efficacious to uphold them—that manifests itself as a guiding principle in Congress, or even in the recommendations to Congress. There should be such a military policy, and it should carry on from administration to administration, from Congress to Congress, and be considered a part of our foreign affairs policy, as little open to attack from within our own household as the external policies on which it is founded. Our form of government, the immensity of our country, and our isolated posi-

tion, almost insular as far as other first-class nations having great military strength are concerned, all doubtless conspire to cause the general lack of interest of our people in foreign affairs, which is the ultimate cause why there is so little appreciation of the underlying need for a strong navy. The navy is popular just now, and to that degree it is fortunate; but the roots of its existence should lie in deeper ground than popularity. It is to be hoped that the completion of the canal may serve to broaden the national outlook, and that we may be able to look back to it in coming years as the period in which a reasoned national policy, founded on national aims, shall have had its birth in the country at large.

There would be no excuse for a failure of the navy itself to have a "reason for the faith that is in us"; nor can that reproach be laid at the door of the navy, which has for years had a definite, consistent policy as expressed by the responsible advisers of the Navy Department. Moreover, the effect of the canal upon that policy has been carefully kept in mind since the day the canal was started.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

"COLUMN" AS A BATTLE FORMATION.

By LIEUT. COMMANDER DUDLEY W. KNOX, U. S. NAVY.

INTRODUCTORY.

Within the last few years a general opinion has gradually crystallized in the service that the conventional "column" is the best fighting formation, and that upon battle becoming imminent our fleet should form column and retain the same throughout the fight, following the leader closely on the same courses and at the same speeds.

Uniformity of course and speed being favorable to good shooting, such tactical conceptions are the natural outcome of a period of tremendous gunnery development, and of an intense and almost exclusive interest in that branch of the profession. Surely it is a reason for gratification that the primary weapon should receive such attention. It is far from the writer's intention to decry an advance so imperatively necessary to war preparation. Needless to say he is emphatically in sympathy with every effort to increase our skill in the delivery of hard blows in action. All the preliminary strategy and tactics of a campaign will count for little unless they can be crowned by many hits rapidly delivered.

But with greater emphasis it is urged that the ability to shoot in this manner is not the sum total of war nor even of tactics, and that it is a deplorable feature of the recent gunnery development that due interest in tactical and strategical advance has been smothered by that stimulated in gunnery. It is high time that we orient ourselves; that we pause, and take stock of what has been already accomplished towards a successful naval campaign, as well as of what remains yet to be done to attain more complete readiness for war.

GENERAL CONSIDERATIONS.

Strategy is the art of using battles in war. It determines when and where battle should be sought or accepted. A tactical victory may prove a strategic defeat and actually harm the end in view of the war. It is fitting that serious attention be devoted to proficiency in this art.

Tactics is the theory of the combat. It comprises all the factors that enter into battle, aiming to assign due weight to each. It recognizes that a one-sided development may be a source of weakness. Morale, leadership, the power of combination, mobility, and fire-power, are interdependent factors. They are all links of the same chain. Of how much use is the power to shoot well if our personnel lacks steadiness, combative ardor, or stamina? What will gunnery profit us if admirals and captains fail in their mission of using it at the right time and place, and in an advantageous manner? Will not good shooting be fruitless unless that of each ship is co-ordinated with the remainder of the fleet to produce mutually supported effort? Are good crews and good ordnance an asset if the mobility and the power of maneuver are lacking to get them into action?

Von Moltke gave expression to the idea that the art of war consisted in making the most of the means at hand. Every single factor that can in any degree contribute to success must be developed during peace and used in war to the limit of its possibilities. This is indeed a far cry from the conception of limiting our fleet tactics to that of the gun, to the exclusion of all other tactical elements, which is in effect the substance of the narrow "column doctrine" now existing.

THE MORAL FACTOR IN TACTICS.

It would require too much space to discuss this factor in more than a very casual way, or from any other aspect than is pertinent to the subject in hand.

Years of concentrated application to the problem of producing the maximum of hits per minute on the target, has evolved, perhaps unconsciously, a *material* conception of battle to a degree that is disquieting. The belief is very prevalent that a ship is a perfected unit, ready for the battle line, when her crew has been so trained that it can shoot well and steam well; no other qualifica-

tion being deemed vitally essential. Our habitual point of view is a consideration of what *material* damage to hostile *ships* would result from well spotted and well bunched salvos. Little comment is heard of the effect of such salvos on hostile *crews,* nor of the effect on our own crews of accurate hostile salvos.

To defeat an army it is not necessary to wound or kill more than a small fraction of it. To win a sea fight it is unnecessary to sink or disable more than a few ships. It has been frequently the case that at the moment of victory, the victor has sustained the greatest losses. But little reflection is required to demonstrate that the controlling factor in battle is some other besides the ability to shoot fast and accurately, and the power to inflict material damage.

All profound students of war and all great participants in it concur in emphasizing the fact that battle is primarily a *moral* contest. That side invariably wins which longest cherishes the conviction that it will win. Victory is an accomplished fact from the moment the belief takes possession of the enemy that he cannot win. Only in so far as inflicted material damage contributes to this attainment is it of value in winning the fight.

It has been said that Napoleon was justified in taking many of his greatest risks only because of his well founded conviction that the French army was superior in fighting power to any of its opponents. Yet this great soldier did not base his tactics on this fact. He was not satisfied with lining his army up parallel to that of the enemy and winning through sheer superiority of fighting power. On the contrary no man ever lived who sought more earnestly nor planned more astutely to gain success primarily by means of shattering the *morale* of the opposing forces. All his plans, dispositions, and tactical measures were made chiefly to that end. Cannot this example be of profit to us?

Few things are so stimulating to one's own morale as the adoption of a vigorous offensive. This fact is so well known and so obvious that there is little need for further discussion of it. Undoubtedly it will be generally accepted. Probably the adherents of the "column doctrine," as outlined in the introduction to this paper, will not admit that it is a defensive doctrine. No doubt most of them will contend that "the defensive" would be far from their intention on adopting this plan previous to going into

action. Yet an analysis of the doctrine will demonstrate it to be mainly defensive. One may steam boldly into fighting range in any given formation; so far the offensive will be granted to have been taken. But when column is formed with a view to its permanent retention during the remainder of the battle, come what will, what then has become of the offensive idea? Certainly the fight is not being forced, but is being submitted to.

Second to no other consideration in its influence on morale is *surprise*. Does the "column doctrine" favor surprising the enemy? In the belief of the writer it eliminates the possibility of effectively so doing, except in a manner agreeable to him. Of course surprise in the sense of making contact before the enemy suspects the near presence of our fleet is not being considered and does not enter into this discussion. Does the column doctrine render the fleet adopting it susceptible and sensitive to surprise? Perhaps this question can be best answered by propounding others. What is to be done if the enemy divides and, leaving a strong fast force to prevent our head from turning to attack his tail, makes an attempt in force to enfilade our tail? What will the following ships do if the head is capped or placed under cross fire? What procedure will be followed if the leading ships run onto a mine field, or receive an unexpected torpedo attack in force strongly supported? What will be done if part of the fleet is enveloped in smoke while the remainder is receiving the bulk of the enemy's fire? What is the reply to the appearance of periscopes near the center or rear center of the formation? Can any other effective surprise be devised against a long column blindly following in the wake of the leader?

HISTORICAL RÉSUMÉ.

Existing records of fleet actions during the galley period are far from complete, but they nevertheless indicate rather a high state of tactical development. During the evolution of the sailing ship, however, the art of tactics was lost, and the earlier fleet engagements with that type of ship resembled more than anything else a conflict between two mobs—each man rushing in and striking right and left at whatever enemy he could reach. There was no plan, no organization, no formation, and no co-ordination of effort. The individual initiative of captains was very great, each

ship selecting for an opponent whichever enemy ship was most favorably situated for that purpose. The confusion incident to such a method of fighting was of course great, and a frequent blanketing of the fire of friends followed as a natural consequence.

At the battle of the Texel (1673), the British fleet, for the first time in the history of sailing ships, used the "line ahead," or "column," as a formation in battle. The adoption of this formation was the culmination of a slow development, during which it was gradually recognized (1) that order should be preserved, (2) that the fire of friends should not be blanketed, and (3) that individual effort must be subordinated to that of the whole. But the central fact round which the evolution of this formation took place, was that the British method of fighting endeavored first to damage opponents by *gun-fire* before the attempt to board was made. Continental navies up to this period fought with a view to boarding with the least delay practicable, and hence were slower than the British to adopt a formation which was favorable to the effective use of guns.

After the battle of the Texel the adoption of the line ahead as a battle formation became general in all the great navies. Individual initiative, which on account of absence of any degree of co-ordination had previously proved unprofitable, died out almost completely, and with its extinction the regulations concerning the preservation of formation became more and more rigid. Formation grew to be a fetish—an end rather than a means—and so inflexible were the instructions with regard to it, that death was for many years the penalty for violating it. The preservation of formation came above all else and this led to defensive dispositions and defensive fighting.

Between the Dutch wars and the advent of Nelson the fighting instructions were very gradually developed, and the exposition of tactical principles reached a comparatively high state. Most of the fundamentals were recognized, at least in some degree. They were not, however, well understood, and were so obscured by this lack of understanding as well as by strictly prescribed adherence to a mass of antiquated forms and conventions, that their application was but indifferently done.

It remained for Nelson to weed out those forms and conventions in the tactical propaganda inherited from previous ages,

which stifled the proper application of the fundamental principles. He understood that what mattered was the substance and not the form. It should be noted in passing that Nelson's genius consisted of even far more than the codification of tactical principles and the correct application of them to the conditions of his time. He invented, applied, evolved and perfected a system of command, the lack of which had been mainly responsible for the failure of his predecessors, many of whom possessed tactical sense nearly equal to his own. This system of command so successfully used by the great admiral expired with him and, strange to say, has but seldom been even duly appreciated in navies since, much less adopted and used to any advantage.

Notwithstanding that in his day the gun was the primary weapon, Nelson abandoned the conventional column as a fighting formation, and substituted for the previous rigid tactics the application of broad principles. At Trafalgar he defeated an opposing fleet which used only the column, and there amply justified his innovations. No fleet action since Trafalgar has been won by the "Column Doctrine." On the contrary the victors at Lissa and Tsushima adopted other tactics, while the vanquished in each case, strange to say, adhered to the column—the refuge of weakness.

There is a curious similarity between the conditions of the tactical art just preceding the advent of Nelson, and the present day conditions. The lack of a system of command; a confusion of ideas; the recognition of certain principles; the blind adherence to certain forms and conventions; and the failure generally to cull out the essential principles from the maze of half formed beliefs and immature instructions. The deductive development has been done; the inductive theory and application remain wofully incomplete. Certainly an exhaustive study of Nelson and his methods should be worth the time of all officers.

SOME DANGERS INHERENT IN THE "COLUMN DOCTRINE" AS ACCEPTED AT PRESENT.

It must be admitted that the conception of following in the wake of the leader during an engagement has great simplicity—and this is no small virtue—to commend it, as well as the advantage previously mentioned of facilitating good gunnery. But its

very simplicity is what makes the general unthinking acceptance of the doctrine most dangerous. If this is all the tactics that are to be required in action, well may it be asked, what need is there for spending valuable time in the study of elaborate tactical notions, or for devoting great effort to develop a high degree of initiative in subordinate leaders together with a comprehensive system of command and a profound set of doctrines? Those who have blindly accepted "following the leader" as the sum of battle tactics will naturally conclude that there is little real need for the development of these tactical auxiliaries. If such conclusions become general the subject of tactics will occupy a very secondary place in professional interest and esteem, and its development will be greatly retarded because the body of officers will recognize "tactics" only as a term defining the question of position keeping and interior geometric movements, and will fail to comprehend its broad principles or its true essence. Indeed is not this dangerous condition of affairs, both with respect to the premises and the conclusions, already realized?

In every naval action there will very quickly develop a stage when order, formation, and plans are badly paralyzed, and at this time united action will be impossible except through subordinate commanders who know tactics thoroughly and are uniformly indoctrinated with the views of their commander-in-chief. This will be the critical stage of the action; that which has gone before will be but introductory. In this situation it may even be advisable to abandon all formation in order to throw the mass of our forces into a critical area. Subordinates who then act in accordance with previously formulated sound doctrine, in harmony with their fellows, in keeping with tactical principles, and in loyal adherence to the general plan of their chief, will win the fight for him in the face of vastly superior forces, if the latter be not similarly guided.

The conventional column may be fortunate enough to escape early confusion due to a destroyer or a fast wing attack on its head, and with good grace arrive at the critical stage described in the preceding paragraph. Thereafter, so long as it is not thrown into confusion and holds together, no individual initiative is required of anyone but the leader; following in wake produces perfect co-ordination of movement. If the enemy is good enough

to adopt a similar procedure, the defects of our own method will not become apparent. But what would happen to such a "snake" column on meeting an up-to-date enemy who knew tactics and gunnery too, would be difficult to predict—but surely sad to relate. Once the heavy punishment stage is reached and the column begins to disintegrate in spots, the hitherto perfect co-ordination will become chaos. Lack of doctrine, lack of co-ordinated initiative, and poverty of tactical conception will bring panic and rout long before it is justifiable.

"GROUP-COLUMN" DOCTRINE, AND THE INITIATIVE.

The writer hopes that the foregoing will not create a false opinion of his own views concerning tactical formation and movement in action. As will be shown later, it is granted that some semblance of column is the normal battle formation. But there is a vast difference between recognizing such fact to be merely a probable outcome of the effort to apply fundamental tactical principles during the various stages of battle, and assuming that there is no other formation tenable, even under unusual or unexpected circumstances. Belief in the latter precept will surely weaken ability to cope with any eccentric movement of the enemy. The football team recognizes a certain line-up as the best under normal conditions, to attack or receive the attack of their opponents. But eccentric line-ups are nevertheless devised for certain offensive purposes, and abnormal defensive formations to meet such attacks are assumed when occasion demands, in accordance with well established principles of the game. Victory rarely comes to the side not prepared either to take care of unexpected attack, nor to put into practice unusual plays calculated to upset the equilibrium of their opponents.

The principles involved both in football and in naval warfare are that formation is but a means to an end and is therefore a secondary consideration; that the proper formation to meet a given situation will depend upon that situation; that a fighting distribution and arrangement should be sought at every stage which will permit the employment of mass against hostile fractions; that the object of weapons is to serve in fighting, and not that the mode of fighting should have as its end the service of the weapons; and finally, that morale rather than formation or weapons is the chief source of victory.

From the beginning of battle the object of each side will be to so distribute forces that the fundamental principle of tactics (concentration of own mass against enemy fractions) may be applied. But if each fleet seeks this object, each will concentrate forces as closely as practicable without restricting power of maneuver, and each side will present its broadsides to the enemy when within range. Somewhat automatically then, the normal result will be two nearly parallel approximate columns, moving in the same general direction at the maximum formation speed of each. Many variations are not only possible but likely under varying circumstances.

It does not seem at all necessary that the formation should be a precise one, nor that, even in the interest of good gunnery, the leader be followed. The preservation of the line of bearing at nearly right angles to the bearing of the enemy is a more logical thumb rule. Neither is it incompatible with accurate shooting that initiative be denied to all except the column leader. In other words there is no valid reason for adhering to the "snake" column; on the contrary there is very vital reason for having an "organized column." By the latter term is meant a formation in which subdivisions, comprising three or more ships, each have a commander whose duty is to carry on the fight largely on his own initiative.

Certain essential restrictions on this initiative are, however, necessary to the end that unity of action be attained. The subordinate commanders must be students of tactics and thoroughly versed in its principles. They must be accustomed to working together in tactical situations. They should be governed by a system of command which fixes clearly the restrictions, duties and responsibilities of each in any situation that may arise. They must be uniformly indoctrinated in accordance with the views of their chief, and should have confidence in the soundness of such doctrine. They should be thoroughly acquainted with the particular plan of the commander-in-chief intended to govern that battle. Above all, far above all else, they must be *loyal to the plan* in every act.

Once begun in earnest the battle must resolve itself into the algebraic sum of the conduct of subordinate commanders. No matter what the wishes of an admiral may be with regard to giv-

ing his personal direction at various points of the battlefield, unreliability of signalling, probably, but in any event the time element, certainly, will make such course unsatisfactory. If the efforts of the subordinate commanders are well co-ordinated and loyally made in accordance with a good plan, little else can be done towards the attainment of victory. If, on the other hand, these commanders are tied down to a rigid formation and by inflexible instructions, the long snake will move heedlessly on to its own destruction. With the privilege granted them of doing the right thing at the right time, the initial flexible "organized" column may assume a variety of shapes during the battle, each suited to the immediate situation, and each having in view, not the essentially narrow and dangerous end of undisturbed gun-fire, but the broader and saner object of the concentration of mass against fractions and the disruption of enemy morale.

DISCUSSION.

"Column" as a Battle Formation.

COMMANDER W. V. PRATT, U. S. Navy.—I am familiar with this article, having read it with great interest when it was first produced at the War College. The writer has a clear conception of tactics. It is not an attempt to decry the value of columns. It is an effort to show that for battle, sound principles, flexibility, loyalty to and understanding of the end in view must supplant hazy or false conception of principles, too much rigidity, loyalty to forms rather than spirit and failure to thoroughly appreciate the end to be gained.

Column is but the expression of that method which brings most guns to bear in the shortest time, in the simplest way, on the most vulnerable parts of the enemy. When column can do this it is good. When it cannot it should be applied only to such units as may do it.

To hold to rigid column, when it becomes disadvantageous, implies uncertainty on the part of the leader. He is not certain of himself, in that he is not sure he recognizes the crucial moment for a change of idea. He is also uncertain of the action of his subordinates. For such, column may be the easiest way out of the difficulty; still it savors of blind, ignorant obedience, rather than of loyal understanding and co-operation.

LIEUTENANT COMMANDER A. BRONSON, U. S. Navy.—The drift of this article conveys the impression that its writer disapproves of the single column as a battle formation and that he believes the service, as a whole, committed to that formation—a "general opinion crystallized in the service that the conventional column is the best fighting formation." The article, therefore, will occasion some surprise to those who not only were unaware of the existence of the crystallized opinion aforesaid, but who further deemed the disapproval of the single-column formation so general as to render rather unnecessary a serious attack upon that formation.

When all the possibilities of an action between great fleets are considered, it is hard to find substantial grounds on which to advocate the column formation for the battle line—the stationing of all battleships in a single line ahead. It is the simplest of all formations and it obviates signalling, but other advantages it has not and its weakness is great. Our present battle strength, so aligned, would cover about eight miles of sea from van to rear. It would not be over-difficult for an aggressive enemy, utilizing to the full the speeds of his various squadrons, to concentrate his forces on the head of that long, slow-moving line in such a manner as to leave substantially half our battle fleet out of action. A few minutes spent on drawing a line diagram to scale will demonstrate how the units of an enemy fleet could be placed to attain such an end, and on the game board

a force maneuvered by squadrons has actually succeeded in so concentrating on the head of a fleet in column. It is unquestionably true that if the head of the column is kept continually turning away from the enemy, thereby forcing him to steam on an outer arc, it will be made more difficult for the opposing squadrons to reach the positions desired and their progress thereto will be materially delayed, but, with skillful handling, the process should be but a matter of time. Sooner or later a fast wing will likely put an end to further turning away.

There is also to be considered the fact that when the fleet in column first heads off from the enemy it then and there and thereby places itself on the defensive, and military commentators have frequently assured us that a force placed on the defensive is already half defeated. Opposed is the mobile aggressive enemy, forcing the fight and ready and eager to take advantage of the first opening his adversary, through blunder or misfortune, may offer; whereas the unwieldy, half-retreating column can do little better than persevere in its sinuous crawl over the face of the waters and pray that the enemy may be sufficiently indiscreet to open the action prematurely.

By forming the fleet in column we force the pre-dreadnought ships, whose offensive strength lies in their broadside batteries, to fight at the same range as the all-big-gun ships. The rise of the new type of battleship has obscured the fact that six and seven and eight-inch guns are still guns and mighty good guns, too, at their ranges. But to make proper use of them the ships carrying them must be fought at comparatively short ranges, whereas to get the full value of the dreadnoughts these latter should keep the enemy at a distance. To fight these two very distinct types of ships at the same range is to fail to utilize the full strength of either one type or the other. Possibly the ideal battle alignment would be presented were our pre-dreadnoughts to engage the enemy's dreadnoughts at short range while our dreadnoughts engaged his pre-dreadnoughts at long range.

By forming the fleet in column we decrease the battle speed of the dreadnoughts from 19 knots to the 13-knot speed of the old ships, and we thereby make of no avail the sacrifice of the dreadnought armor and armament whereby their high speed was attained. That eventually the fleet will be composed entirely of dreadnoughts—and from recent indications that day is very remote—does not now concern us; at present we are interested only in the action which may be fought next month or next year, not in that of ten or fifteen years hence. Moreover, it is to be seriously doubted whether we will ever have a homogeneous fleet; certainly in these days of rapid and marked advances in the mechanical sciences no one can guarantee it. In any event it will be time enough when we get the ships to modify the tactics to fit them. Our battle strength now lies in the pre-dreadnoughts; our present tactics must be suited to them.

The entire strength of a sea force will be exerted only when the full strength of each of its units is exerted, or, in other words, when each of its units is fought at its maximum battle speed and at the range best suited to its guns, provided only that such handling of the component parts is

consistent with the coherence of the whole. And here, of course, in the proviso, lies the rub. It can hardly be denied that a fleet fought by squadrons (the term "squadron" is intended in its elastic sense), each squadron composed of vessels practically homogeneous, each fighting at the range and speed peculiar to its type, and each handled in perfect accord with the other battle units—it cannot reasonably be contended that such a fleet would not prove a far more formidable adversary than one which in its tactics simulates the movements of a sluggish snake, waiting in meekness and with such resignation as it can command for the moment when its persecutor will see fit to strike. But without the existence of a high degree of co-ordination between the various units, it is obvious that a fleet so handled in separate squadrons would be exposed to grave danger. The movements of the units must be so regulated that all will strike the enemy practically simultaneously, otherwise the possibility of defeat in detail is great; and throughout the subsequent action none should mask the fire or interfere with the maneuvers of any of the others. On the game board it has been found difficult to exercise the co-ordination necessary to obtain these two ends; in warfare the difficulty will be much greater. Unquestionably, considerable proficiency in exercising co-ordination can be obtained through the game board, battle drills and the evolution and study of battle plans, all of which may be blanketed by that elusive, though comprehensive, term "doctrine"; but, nevertheless, it is seriously to be doubted whether by these means alone is to be acquired that high degree of proficiency in handling a large fleet by squadrons whereby victory in battle can be made reasonably certain. No matter how capable the squadron commanders, no matter how thoroughly they are "indoctrinated," how complete their understanding and loyalty to the battle plan of the commander-in-chief, how comprehensive and carefully considered that plan;—there still will exist a strong possibility that at some stage of the action a situation will arise necessitating the control of the entire force by one mind if concord is to be had. It is not possible that any battle plan sufficiently comprehensive to provide for all possible contingencies of an engagement with an active and intelligent enemy can be evolved; sooner or later during the action a stage is likely to be reached where neither plan nor "doctrine" is a guide. When that situation arises it may be that the decisions of the squadron commanders will not be in harmony, and confusion, interference and disaster may result. Unity of action can be assured in such case only by the ability of the commander-in-chief to take instant control of all the units of his fleet.

This is a very large order, of course. To fill it the commander-in-chief must be equipped with reliable means for communicating instantaneously with his subordinate commanders. A delay of five minutes may be fatal. We have no such means of communication as yet but the radio telegraph and telephone are still in their infancy. Furthermore, the commander-in-chief, in order to exercise intelligent control of the units of his force, must be so situated that he can be cognizant with mathematical accuracy of the locations of those units. In other words, he should be approximately equidistant from all of them and so located as to have a clear view of the

battle field. Nor should his attention be distracted by casualties on his own vessel or by saddling him with the command of one of the squadrons. These requirements can be fulfilled only by making the fleet flagship an independent ship and stationing it on the disengaged side of the firing line.

To fight a fleet in separate detachments is unquestionably a far more complex task than to fight it in a single column. Possibly that is the reason why the latter formation has its advocates. But if it be admitted that could a fleet be so fought with proper co-ordination of its parts it would be more formidable than the same fleet in column, the question at issue, then, becomes merely one of the possibility of obtaining such co-ordination. While there yet exists no exact knowledge which would render possible an authoritative answer in the affirmative to this question, there is also in existence no exact knowledge which would render possible the answer in the negative. The dependent stake is large; the answer should be found.

LIEUTENANT COMMANDER E. J. KING, U. S. Navy.—It is to be hoped that Lieutenant Commander Knox's paper on "'Column' as a Battle Formation" initiates a careful and methodical examination into the merits of all "sea-going" formations which are rigid in their requirements as to courses, distances and intervals, to the end that well-founded conclusions may be had as to whether such rigid requirements are necessary and advisable or immaterial and perhaps dangerous to success in battle.

In looking into this question of arrangements for co-ordination and success in sea battles it would seem well to examine into the development of land battles, for there will be found application of the same fundamental principles that must obtain in any successful battle, be it on land or sea, and of which the "concentration on fractions" that Lieutenant Commander Knox emphasizes is among the most important.

It may be objected, with sincerity, that battles on the sea are very different from battles on land; they are different, but not in principle; the difference lies in the application of the principle. These differences in the application of principles may be thought of as caused by differences in weapons, in shelter, in mode of injuring the enemy, of transport of weapons, of transport of personnel, of supplies, of communications, etc.

Perhaps the most striking single difference between land battles and sea battles may be expressed as the mobility of the forces engaged, but it would seem possible and practicable to deal with this great factor, mobility, in much the same way that one learns to co-ordinate the movements of the body to circumstances external to the body and not under its control. This attainment is understood to be just what is aimed at where "initiative of the subordinate" is employed to govern the actions of "groups" in conformity with a "sound tactical doctrine" and always with "loyalty to the general plan."

It appears, at first glance, that if on the sea fixed and rigid requirements as to courses, distances and intervals are adhered to, we may be at a stage in the development of sea tactics similar to that in land tactics, where much stress was laid upon the necessity of keeping the troops "dressed"; land tactics have long since passed that stage. Are such requirements necessary

in sea battles? Do they help or hinder? Can one not conceive of a sea-battle formation where the general "line of battle" is opposed to and "contains" the enemy "line of battle"? Where "groups" are handled in such flexible relation one with another and with the whole as to be able to make the best possible use of their fighting power at their parts of the "line of battle" and thereby further the general plan of battle? Where "fractions" of the enemy are concentrated upon or contained or repulsed or pursued according to the requirements of success for the whole force, *i. e.*, with loyalty to the general plan?

LIEUT. COMMANDER L. A. COTTEN, U. S. Navy.—It seemed high time that some one was pointing out, as Lieut. Commander Knox has so ably done, that while the flexible column has its advantages as a battle formation, still it is far from being the last word in battle tactics. We all recognize that it is necessary to creep before walking, but, having learned to creep, it is most important that we should not be so obsessed by the pleasure of creeping that we neglect to learn to walk. After all, creeping is good only in so far as it is preliminary to walking, and one who remains content with creeping cannot reasonably expect success in competition with one who has developed more advanced forms of locomotion.

A fleet is subdivided into appropriate tactical units in order that they may be handled as such, either by the will of the commander-in-chief or of the commanders of such tactical units as the exigencies of the moment demand. To require these tactical units to follow blindly, the commander-in-chief is to give up the benefit of our tactical organization and the initiative of our unit commanders. Were it possible to foresee each phase of a battle, it would be quite feasible for the commander-in-chief to prepare to meet each phase before the event, but that is manifestly impossible, and the only alternative is the initiative of the unit commanders exercised without restraint *within the plan of battle of the commander-in-chief.*

As Mr. Knox points out, a certain formation is best under *normal* conditions. That formation, then, should be adopted until the situation indicates that it is *abnormal.* Some form of column ("organized"?) seems to meet the normal condition on account of its simplicity and influence on gunnery, and, on account of the ease with which it may be changed into such grouping as the exigencies of the moment require, it seems also to meet the abnormal conditions when the initiative of unit commanders is allowed to exercise itself, provided such initiative is trained through use and founded on a previously acquired knowledge of correct principles.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE NAVAL WAR COLLEGE, THE GENERAL BOARD, AND THE OFFICE OF NAVAL INTELLIGENCE.

By COMMANDER W. S. CROSLEY, U. S. Navy.

Much of what follows will be recognized by many officers as true and accepted by them without argument. In fact, it has very frequently been the experience of those attempting to write a paper of this nature that they have been received with statements to the effect that they were not communicating anything new.

Probably it would be difficult for any of us to write upon professional subjects without reflecting the thoughts of others; few of us would be apt to submit a paper in which our brother officers would find nothing good!

By some officers, those anxious to learn and who have lacked opportunity, the arguments will be accepted and the statements believed. There will be officers, however, who will continue to look upon all pertaining to the title of this article with a certain amount of suspicion, and who will continue to smile inwardly at the three institutions, and who honestly believe they are not needed.

We need all three types of officers, but we need most more of those who already know, and these can only be recruited from the second lot, who are willing and anxious to be convinced.

Of the third lot, some can be convinced by the proper presentation of facts, and if this paper converts one man to the belief that what he calls " high brows " and " brain trusts " are essentials for success in war, this effort will have succeeded.

Suppose we assume that all officers in a naval service are expert electricians, but they know nothing about, and do not believe in, steam. The result, upon going to sea, could be foretold without a diagram.

Reverse the assumption and the answer to the problem is equally evident.

In other words, we must have experts in *both* electricity and steam. Take any branch of our widely diversified profession, and similar arguments will show the necessity for specialization.

It can readily be shown by a consideration of the characteristics of officers on both the retired and the active lists that an expert in one subject is sometimes quite helpless (and hopeless, too,) in another. It is quite unnecessary to name names, for most of us know examples aplenty, and besides, we know our own limitations pretty well.

It has frequently been remarked that "it is not the star men at the Naval Academy who make the best officers," but, not having been permitted to wear a star myself, I am prepared to argue this matter a bit.

In the first place, there are really very few "stars" who graduate, so it is rather easier to pick a poor officer from the few than from the many who are unable to "star."

In the days when an officer's ability to handle a ship under sail, and to get the maximum amount of work out of a crew of double-fisted, big-hearted, rough-and-ready sailormen from all countries in the world, represented his efficiency, probably the "wooden-section" outshone the first section; at any rate we know of enough examples to state the general rule. But these requirements no longer exist, since sailing a ship, or even a ship's boat, has become a luxury not often obtainable nowadays, and the character of the personnel to be handled has changed as greatly as the material. Therefore this rule about "stars" must not be accepted because of tradition, but may even readily be disproved by individuals now in the service.

It remains a fact, however, that some officers who excel in writing long "screeds," and convincing ones, too, about strategy, for instance, are rather in the way on board ship. Some of them succeed in bringing about a lot of unneccessary unhappiness afloat. Some of them positively cannot handle a ship or handle men to an advantage.

The "Plucking Board" has found some officers on account of this "unhappy ship" business, but, as this board has had access to *all* records concerning an officer, it is right to assume that the bad outweighed the good, even if some of them might have shown ability to expound upon strategy, or another so-called "high-brow" branch.

We need strategists and tacticians, "high-brows" as distinguished from the horny-handed sailor, as much as we need mechanics, electricians, and ship-handlers. Probably the men who have shown at the Naval Academy they can study and think well will be the best from whom to recruit this type!

One reason the need is not so generally understood is because we have been at peace for some years, and we haven't really *needed* "high-brows" for a *very* long time.

The need for officers qualified to solve the strategical and tactical problems, at once evident when war threatens, is somewhat similar to our need that will then arise for auxiliaries.

Some of the auxiliaries we don't really *need* in peace time (except for increased efficiency and for economy), but during war they are as necessary as the battleships. Anyone familiar with the scramble that had to be made in 1898 for auxiliaries, and with some of the poor make-shifts we had to make the best of, will agree that it would have been a good plan to have had some officers working on such matters before war threatened.

It is also a matter of official record that a board of officers was assembled at that time to consider and advise upon policy, strategy, and tactics.

How much better it would have been to have had all this worked out beforehand—to have been able to consult a card-catalogue and pull out a well-digested plan!

It takes about three years to get a battleship from her keel-laying to the fighting line. It requires many times three years to develop an officer qualified to employ that battleship, with others, to the best advantage in war.

There are some natural strategists. Unfortunately the number is small and the opportunities to develop the natural ability have been, in the past, too few. Doubtless there are officers now on the retired list who, if they could have had the benefits of the War College course (not once, but from the time they were lieutenants till they become captains, from time to time), would no doubt have presented us with some definite policies, almost rules, concerning strategy and tactics.

There are some officers now who know that a certain maneuver in the presence of the enemy (for instance) would result in defeat.

Why should not that fact, with others equally as certain, be a matter of common (confidential, if you like) knowledge among all commissioned officers?

Owing to the great number of games that have been played at the War College, certain principles are recognized by those officers who have been fortunate enough to get the experience. Why not codify these, spread the information, invite comment?

The duties of a general staff have been recognized by major nations for some years.

Futile efforts have been made to include a general staff in the organization of our Navy Department. Probably lack of information on the part of our law makers is the only reason we haven't one, for the personal objections that have actually prevented legislation could not have prevailed against patriotism backed by knowledge.

It is a possibility that when war threatens we may be fortunate enough to find a genius, or more than one, who may, without previous study, advise the civilian Secretary (the civil administration) as to the best strategy and military conduct of the war, from a naval point of view, but how much better it would be to have a number of officers *previously* trained by study of other wars, by strategical and tactical games, and by constant thought inspired by these on the various problems presented, to be able to answer the questions as they arise!

The best personnel in the world, the most accurate marksmanship, the finest vessels, and the country, may all be sacrificed by a failure to grasp the possibilities brought about by the information that an enemy fleet has sailed from a given port bound in a given direction.

Those who have previously studied such a problem will at once be able to say, with authority, "he is bound there, or here, or there, and we must do this, or that, or this!"

Others may guess, and possibly guess right, but the stake is too high to be won (or lost) by guesswork.

Several books have been written about the game of whist, with its two more recent modifications. One who has played the games can read these books and learn things from them. Only a genius could, without present or previous practice, read the book and play a satisfactory game. Quoting from many writers, and most recently from Captain Sims, "war is a game," and the same rea-

soning applies to the correct solution of its varied problems. Reading alone will not suffice—we must have sub-caliber practice!

The General Board is the nearest organization to a general staff we have been able to establish, and as that organization cannot exercise authority (and has usually had opposition), it lacks that great necessity to military efficiency—responsibility.

The only responsibility falling to a member of the General Board is that resulting from his loyalty and his professional pride. Of course we may always count upon these, but they are poor substitutes for the real thing, for in a military organization sentiment has no real place. There are too many demonstrations of the correctness of the definition given war by General Sherman to warrant much argument on this score.

At times the General Board has been called upon for recommendations upon matters concerning which important information has not been furnished, for the simple reason that no machinery existed to insure its delivery. A proper organization would prevent this to a great degree, but a proper organization in our Navy Department can only result from legislation—a difficult thing to get.

The Naval War College and the office of Naval Intelligence are so closely related to the duties of the General Board that the three organizations should be under one roof, and the officers detailed to the three should be in constant daily consultation, with committees representing all three in frequent session.

There should be one head—properly a chief of general staff—to whom the heads of the three natural divisions should be responsible. Each should know the needs of the others, and the work of each should be so regulated that these needs might best be met.

No one of the three can intelligently carry on without the others, and their relations should be those of fact, not hampered by the requirements of correspondence, with its resulting delays and well-known limitations.

The office of Naval Intelligence seems somewhat handicapped by lack of funds, and of course the only relief from this situation must come from the Congress, but it seems that a re-organization to meet the demands of the department, the bureaus, the War College, and the General Board, is not only practicable, but easy to accomplish.

The War College, the office of Naval Intelligence, and the General Board should have a common stenographic force, with a chief clerk to regulate its use, subject to the control of an officer-secretary, who would decide upon the relative urgency of the work. Much delay now existing would be avoided in this way.

Of course the immediate foregoing is not suggested as a total solution to existing handicaps—it offers a basis upon which to begin.

It has recently come to my knowledge that several offices under the Navy Department have applied to a civilian business office for the same information. Putting aside the loss from unnecessary wasted activity on the part of all but one of the branches of the department, such procedure probably does most harm by convincing the recipient of the requests for information of the lack of departmental organization. We must avoid such unfavorable just criticism by improving our organization. While we need publicity, we do not need the very just unfavorable comment caused by the incident cited. It is an example of what criticism teaches us, but why remain liable to a repetition thereof on the same subject?

The General Board, since its origin, has partly solved the problem of co-ordination with the War College and the office of Naval Intelligence by alternating between Washington and Newport.

This practice was one of expediency, and was brought about by the late Rear-Admiral Henry C. Taylor, U. S. Navy, whose loss to the navy can only be appreciated by those fortunate enough to have served intimately enough with him to know his aims.

However, when in Washington the General Board suffers because of its physical distance from the War College, which even the efficiency of the United States mail cannot bridge. The same applies as regards the office of Naval Intelligence (to omit details of the inefficiency resulting from the absence of the Board from its files), when the General Board is in Newport.

A study of the navy regulations on the subject will readily convince one of the close relations of the three offices in theory.

Heretofore insurmountable obstacles have prevented their closer physical proximity.

We can never get the full benefit of the valuable work done in the three organizations until we do get this physical proximity,

and our efforts to accomplish it should not cease until the result is obtained.

Very brief consideration and general information only should convince one that the only logical locality for these "three-in-one" is in Washington.

They form a most necessary part of the Navy Department, and while the ideal arrangement of the department would be to house it all under one roof, we simply cannot hope for such a condition in the near future. We *may* hope to have the department in one city, and probably the most obstinate objection to be overcome would be the deep-rooted belief in some parts of official Washington to the effect that *all* naval officers want duty in the Capital City, and that the minimum possible number should be permitted to reside and have duty there.

By way of suggestion, why would not a proper building for the Navy Department form a dignified, valuable, and lasting "Lincoln Memorial?"

The objections to "ordering officers to Washington" result only from ignorance, and this particular ignorance can be corrected. I suggest that it be corrected!

With the Secretary's aids and the General Board made legal and obligatory, and the housing of the three offices in the title under one roof, our Navy Department would possess a general staff of which we could expect the maximum efficiency, and that seems to be what we are here for.

The facts being so evident to us who are informed, it is our duty to inform those through whom alone we may accomplish the end.

Certainly we are not immune from the *need* of a general staff, and more warlike nations have adopted them.

Possibly because of our lack (as a nation) of a naval policy, we need such a staff rather more than nations possessing such a policy.

The somewhat advertised, much needed and proposed council of national defense would go far towards filling our wants, but could not take the place of a general staff, for the council could not take up the details for which a general staff exists. Probably a council of national defense would go far in the educational direction hereinbefore advocated.

Recently we have been fortunate enough in having an administration in the Navy Department that has, by departmental action, overcome many of the handicaps under which our navy has previously suffered.

The fact that it has been due entirely to individuals forms its weakness, and much of the existing good organization may be entirely done away with by simply failing to provide officers for it.

Owing to the vast amount of instruction necessary to enable mature minds to grasp the details of a naval organization of which they have previously been in total ignorance, the activities of the naval officers in the Navy Department cannot be devoted entirely to their professional duties. Much time has been spent in the past, and without adequate legislation much time will be spent in the future, for the sole reason that we have been and will be on the defensive.

Our arguments are so convincing and self-evident to us that we often fail to impress the uninformed with their truth and justice.

An official suggestion that the Naval War College should be moved to Washington would, at one time, have almost certainly caused its abolition. There has been a well-defined belief among our law makers that all naval officers desired nothing so much as to be ordered to Washington, and more than once Congressional inquiries have handicapped the Navy Department by preventing its natural expansion, due to increased activities afloat and to the growth of the personnel and material.

To those who know there seems no argument that can prove the falsity of the belief that all officers want duty in Washington.

Those of us who have heard so many officers state the opposite as their desires know the belief to be erroneous. How prove it? I suggest that officers having, for some time, been directed to state their preferences as regards duty, it would be rather simple to determine exactly how many have stated their desire to serve in Washington.

This is an example of the difficult educational feature of our organization, and while all who really know about such matters will agree that the offices named in the title of this paper should be physically present in the Navy Department, only a few are in a position to attempt to prove it and to bring it about.

Without ability to anticipate questions that may arise one cannot advance convincing arguments, but it is possible to give

concrete examples existing in nations whose daily existence depends upon military preparedness for war.

Anyone who has read the newspapers during the most recent wars cannot fail to be impressed with the results due to preparedness, and the failures due to a lack of it. Those familiar with our own situation in 1898 have always since then appreciated the efficiency due to readiness and the inevitable mistakes caused by lack of previous plans.

We have, fortunately, been able to progress, but why not *perfect* our readiness?

Under existing legislative sentiment we will need all the advantages to be gained by previous preparation, for it is now certain that the Congres has already handicapped our national defense by failing to provide an "adequate navy."

We all hope that the United States will not be forced into war, but wars are declared suddenly nowadays, and the only *insurance* against a war disastrous to the lives and property of Americans is a sea power, backed by a knowledge of its proper use, that will make it dangerous for another nation to undertake war with us.

It will not be necessary, nor work harm, for us to advertise our condition—the others know it now, and they will take note of any improvements we may be able to bring about.

It will only be a knowledge by them that we are efficient and strong that will prevent war, for we have no right in fact to sit calmly down and announce "We will never go to war!"

With all due respect to the honest gentlemen who believe they can bring about a state of perpetual peace by making statements not upheld by facts, it can scarcely be disputed that we always have had wars since we became a nation, and other nations are at war to-day. What has made us immune?

The Naval War College, the General Board, and the office of Naval Intelligence are as necessary to a proper preparation for war as is the gun factory at Washington.

They are all concrete necessities (name them what you like) of a general staff (and I don't care what you call that, either, so long as it delivers the goods), and example, if nothing else, teaches us that such an organization is a military asset.

It is a fact that in the past much effort has been lost because of a lack of co-ordinated effort.

Congressmen have had positive statements from one officer concerning a particular proposition, and immediately have gotten an equally positive contradictory statement from another, the reason being that one officer knew his subject and the other did not.

We have all known men who found it difficult to say "I don't know" or "My knowledge on that subject is of a general nature, and I must study the details."

None of us may now properly be expected to be experts on *all* relating to our profession, and it is not to our discredit to acknowledge inability to answer questions on subjects with which we are not familiar.

It would be equally consistent to expect us to be familiar with the pilotage of all ports in the world, whether or not we had visited them. It would be as reasonable as to expect a modern lawyer to be familiar with all branches of his profession; or to expect a physician to be a specialist concerning every part of the human anatomy. We know that lawyers and physicians specialize, and, in law courts, for instance, only experts are called.

There have been examples known to many of us of success in obtaining legislation because of co-ordinated effort with knowledge of the subject, when equally valuable measures have failed to succeed because of a lack of knowledge on the part of the law makers.

Therefore, let us decide now what we want and go after it.

I suggest that the thing most urgently needed now is the necessary law to firmly establish a general staff or its equivalent, and as a part thereof should be the combination and co-ordination of the Naval War College, the General Board, and the office of Naval Intelligence.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL STRENGTH IN NAVAL BASES.[1]

By MIDSHIPMAN EDWARD ELLSBERG, CLASS OF 1914, U. S. N. A.

Motto: "War is a business of positions."

Since the conclusion of the war with Spain the navy of the United States has been much in the public eye. That war, which was brought to a quick close by two sweeping victories on the sea, clearly demonstrated to this nation the value of a navy. Since then the navy has received its share of popular attention and support, and it has risen to a higher plane of efficiency. Yet due to popular ignorance of the essentials of a well-balanced navy, this development has been one-sided, for our expenditures have been concentrated on ships alone. To the bulk of our citizens a navy means simply a collection of battleships with perhaps a few destroyers and auxiliaries. But the naval bases, the forces behind the fleet, which render its operations possible and enable it to keep the sea, make no appeal to the public imagination, and they have consequently been neglected.

The fleet's need of shore stations is obvious enough even to the veriest land lubber. He knows, or he has heard, that modern ships are scarcely more than floating machine shops and that all this machinery requires constant overhauling; that ships must be frequently dry-docked and scraped to preserve their speed; and that these ships are dependent upon their bases for supplies of fuel, without which they are absolutely helpless.

"But," says our average citizen, or his Congressman, "what do you want? You have yards enough for these things. Why, there are eleven yards in this country alone. Look at England.

[1] The medal offered by the Admiral Trenchard Section, No. 73, Navy League of the United States, to midshipmen under instruction in English for the best essay on a topic either naval or patriotic in character was awarded for this essay during June week, 1913.

She has a navy twice as large as ours, and yet she has only half as many yards." All of which is true, but what the navy needs is bases, not yards.

It is absolutely necessary to a clear understanding of this question to differentiate between navy yards and naval bases, for of navy yards we have enough, while we are sadly deficient in naval bases. The two have a few things in common. Both contain machine shops and dry docks and both may be made depots of supply, but there the likeness ends. There is one requirement which distinguishes a naval base from a navy yard, and it is their failure to conform to this principle which renders the greater part of our present yards worthless to the fleet in time of war—this is the principle of *position*. A naval base must be so situated that what it has to offer—shops, docks, and fuel—can be utilized by the fleet without the necessity of leaving the theater of war. It must be strategically located with regard to the area of operations; *it must dominate the situation by its location*. This principle of position is best illustrated by Gibraltar, a fortress whose name has become a synonym for strength. Yet how many of our citizens know that what gives Gibraltar its importance is not the fact that its guns control the straits (for a strait 13 miles wide cannot be blocked by guns), but that those guns make impregnable a naval base. Gibraltar exists merely to protect a few dry docks and repair shops. The *fortress* of Gibraltar never has prevented the free passage of ships through those waters; it is the fleet whose base that fortress makes secure that gives England her control of the Mediterranean, and England, realizing this, has spent $200,000,000 upon the defences.

Such a base also was Port Arthur, which the Japanese were compelled to take before the war could be carried farther; but such bases are just what our navy yards are *not*, for most of them are located in out of the way ports, alike inaccessible to our own fleet and incapable of withstanding an enemy's attack.

From this it is apparent that location is of first importance in the case of a naval base, for, given position, everything may be added unto it. As a supplement to favorable location, the ideal base, like Gibraltar, must be in a position easily capable of defence, and it must be well fortified. It should be remembered that the base exists only for the purpose of supplying the fleet. The strategy of our commanders must never be hampered by the

necessity of protecting their bases, or by the fear that these will fall into the enemy's hands. The fleet must be free; it must be able to look upon its base as a refuge, not as a burden; and to this end the base must be capable of defending itself, leaving the fleet to operate without anxiety against the enemy. A naval base must be well located on the line of communications to supply the fleet operating there; it must be a thorn in the enemy's side, a haven from which swift cruisers may rush out to harry his commerce; and it must be a point beyond which he dare not go, leaving it unreduced in his rear.

The points, then, which distinguish a serviceable naval base from a navy yard useful only in time of peace are location and fortification. If we examine carefully our present yards we will find that almost all of them are lacking in these two fundamentals; that they are so badly located as to be useless or so poorly fortified as to require the constant services of the fleet for their defence alone. We have too long allowed this matter to remain a local question, interesting no one save politicians eager to secure jobs and appropriations for constituents, and the result is that we have yards promiscuously scattered over the country without regard to military value. This is a situation which cannot safely exist, for in these days of war on short notice or on no notice at all it behooves us to be prepared.

There are in this country eleven yards, each one of which, presumably, should be fully capable of serving as a base for the fleet. If they cannot so act they have absolutely no reason for being, for the fleet of this nation is its fighting arm and the navy yard exists only to enable that fleet to keep in fighting trim. Nevertheless, fully half of our naval stations are from one reason or another totally precluded from fulfilling the smallest part of their function. Only four yards on this coast are of any service to the fleet —the others are never used. They are a needless expense, but, what is worse, they prevent the establishment of bases where they are really needed. They have several times been slated for extinction, but on each occasion political expedience has carried the day against military efficiency and these needless yards remain. Before we can put our system on a military basis we must rid ourselves of these. An obsolete ship goes quickly out of commission. What greater claim has an obsolete yard to continued existence? These yards served a purpose once, but that time has passed away. Efficiency demands that they be abandoned.

Into this category of obsolete stations fall the yards at Portsmouth, Port Royal, Pensacola, and New Orleans. Portsmouth is near the Charlestown yard and such unnecessary duplication is a waste of strength. In addition, their proximity enables a hostile fleet to watch both places without a material division of its forces. As for Port Royal, a relic of the blockade in the Civil War, no battleship can approach its dock even at her normal draft, and no ship of the Atlantic Fleet ever tries it. How near, then, could a damaged ship approach, when, several compartments flooded, she is probably drawing four or five feet more and must be docked at once or sink?

The yards at Pensacola and New Orleans fail to measure up to the required standard in defensive power. Pensacola is far too open to bombardment, while a ship which entered the Mississippi to go 100 miles inland to the New Orleans yard would, in all probability, find the narrow passes blocked or blockaded when it sought exit.

These are the home yards which have outlived their usefulness. They fail to measure up to the required standard of naval bases in wartime, and they should go.

But a mere weeding out of useless stations is not all that is required. It is more important that we supplant them with real bases which, by location, fortification, and equipment, are able to serve the fleet under all circumstances. The system of bases which our extended and rather vulnerable coast makes necessary, requires careful consideration. Their location, in each instance, should be governed solely by the probable theater of war. Looking at our eastern coast thus, we find that the various centers of naval operations in all likelihood would be New York, Chesapeake Bay, and the Panama Canal, and our system should contain a sound base controlling each of these points.

For the northern coast, Newport offers the best location. Even so long ago as 1773 its natural advantages were recognized by the British naval officers. Strategically it is of the utmost importance, for it controls the approaches to New York City. Its broad bay and narrow entrance, already fortified, make it an ideal site, and all these advantages should be improved by the construction of the necessary docks and shops.

Farther south is Norfolk, admirably situated and equipped to act as a base for our central coast. We have but to remember

that in 1898, when but one squadron was available for the defence of our entire coast, that that squadron was stationed at Hampton Roads, only a few miles from Norfolk, to appreciate the strategic value of this position. The recent action of Congress in taking steps to fortify the Chesapeake Capes, its only approaches, demonstrates that here, at least, we are to have a base worthy of its importance.

On our Gulf Coast we have Key West and Guantanamo, the logical positions from which to defend the approaches to the Caribbean Sea, and consequently to Panama. It is impossible to conceive of a war in which we are participants where the Panama Canal, the link between our two coasts, will not be the first object of attack. It is from these two positions, guarding as they do the entrances to the Gulf and the Caribbean Sea, that this important waterway may best be defended.

Our haphazard system of providing naval bases is well illustrated by the neglect which Guantanamo has suffered. This bay, without doubt the best location for naval purposes within a thousand miles of Panama, was acquired by treaty for the sole object of establishing a base there. Yet, outside of a Y. M. C. A. building, no improvements have been made, the principal reason being that the New Orleans yard has thus far been able to secure all naval appropriations in that quarter for herself.

Our present yards on the west coast leave something to be desired, but they may yet be converted into reasonably efficient bases by dredging channels and improving interior communications. Mare Island and Bremerton, located in the only real harbors on this coast, are fairly well situated to cover our coast cities, but the addition of a third base at Magdalena Bay would materially increase our ability to defend the western approaches to Panama. This site, of course, would have to be acquired from Mexico, but in the present state of affairs such a proceeding should not be difficult. As the Mexican government was once willing to lease this bay to Japan, it might be induced, if properly approached, to do as much for the United States.

Finally, our chain of bases is rounded out by Pearl Harbor in Hawaii, Guam, and Corregidor in the Philippines, positions which, by fortifications built or projected, are destined to control the Pacific. Pearl Harbor in particular must ever be our advance base in the Pacific. It advances our maritime frontier in that

direction twenty-one hundred miles, and puts us within easy steaming distance of the east. No oriental power can attack us without passing close by Hawaii. Here our fleet, near to a powerful base, can safely handle any opposing force, worn out as that force must be by a long voyage, and further handicapped by the fact that it is four thousand miles from any home port from which to draw its precious coal.

This, then, is the situation in which this country finds itself. We support a large number of yards which are worthless, while we possess sites for a number of bases which remain unimproved. In order to enable our fleet to take the sea and fight in whatever quarter threatened interests may make it necessary we must develop the bases from which that fleet may operate. It is high time that we utilize these sites; that we convert them into real naval bases. Some sites require docks, some need fortification; to all of them is necessary a public realization of their value.

Newport, Norfolk, Key West, Guantanamo, Magdalena Bay, Mare Island, Bremerton, Pearl Harbor, Guam, and Corregidor are the links in the chain of bases that we must forge, if we are to bring that part of our navy on the land up to the standard maintained by our fleet upon the sea. We must recognize our needs, and, disregarding local prejudice, abolish what is useless and devote our energies to equipping and fortifying these sites which nature and our interests have destined for the naval bases of America's sea power. For war is a business of positions, no less upon the sea than on the land, and, having the positions, if we fail to utilize them disaster on the sea will ultimately be our portion.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL EFFICIENCY AND COMMAND OF THE SEA.

By LIEUT. COMMANDER LYMAN A. COTTEN, U. S. Navy.

It is a truism that the chief function of a navy is to wage war upon the sea, and all other functions are but derivatives of this chief one. Thus a navy may be a powerful instrument in the maintenance of peace, but only in proportion to its preparedness and efficiency for war, since without these a navy becomes but a meaningless and powerless aggregation of ships. In fact, an inefficient navy may actually become a menace to peace by leading to a false sense of strength and security in the minds of those statesmen and diplomats of a country charged with its policies and international relations. As a case in point may be cited the Spanish Navy before the Spanish-American War. The Spanish statesmen, relying upon a mere physical valuation of their navy, maintained certain policies which led to war, which they would surely not have done could they have read with the clear, prophetic eye of Admiral Cervera that the efficiency of their navy as an instrument of war was so wofully inadequate.

In his "War on the Sea" Darrieus says: "A nation must have a fleet which corresponds to its policy," and he might have added that if a country will not acquire a fleet adequate to its policies it must surrender its policies, if not of its own volition, then under compulsion. But no navy, however large, is adequate for more than a "do-nothing" policy unless it possesses war efficiency, for size and efficiency are by no means synonymous terms when applied to a navy.

Almost invariably in our own country, when the navy is under discussion in the Senate or House of Representatives, the advocates of naval power express themselves as favoring an *efficient* navy, meaning, no doubt, a navy adequate in ships, appliances and personnel, and presupposing that in the hands of the naval per-

sonnel such a navy will be ready to deliver on demand the very highest type of war efficiency.

Thus our navy as an efficient instrument of war is of a dual creation. Congress appropriates money to buy ships, guns and torpedoes, but naval efficiency it cannot buy. This is the creation of the navy personnel, and without this creation the ships, guns and torpedoes are but as a body without a soul. As the musician breathes the soul of music into the musical instrument, so must the navy personnel breathe the soul of efficiency into the navy. Not by genius alone, but by work and thought and study, year in and year out, may efficiency be attained, and even when attained it is as easily dispelled as the mist of the morning and must be retained by more work, thought and study, buttressed by ever-quickening interest, unselfish loyalty and crystal-clear character; for to efficiency, as to learning, there is no royal road.

There may be said to be four classes of efficiency in a navy, each class included in and requisite to the succeeding class. First, there is individual efficiency; second, ship efficiency; third, fleet efficiency, and, fourth, naval efficiency. Each higher class, while of broader scope and more inclusive than the class below, is still incapable of attainment without the efficiency of the lower class. Thus there can be no naval efficiency without efficient fleets, for however wisely naval objectives may be selected, campaigns planned and co-operation effected, unless fleets be efficient there can be no success, and success in war is the final criterion of efficiency. In the same way efficient fleets are dependent upon efficient ships, and efficient ships are not those manned by inefficient individuals. Thus, while the foundation is individual efficiency, the desideratum is naval efficiency in its broadest and most comprehensive sense. It is only this broadest field of efficiency that will be discussed here.

Given efficient fleets, how shall they be used in war so as to most easily accomplish the object for which the war is waged? Where shall be the field of operations, and why? What are the governing motives for the choice?

The first thing to be considered is the *cause* of the war. This may be a vital policy challenged, a principle violated or a national danger threatened. Wars are not caused by abstract principles, but by concrete cases, and these concrete cases always define with a reasonable degree of definiteness the political objective of the

war. War in its broadest sense is but a political instrument, and hence it follows that the political objective of a war must define the military objective. Thus, the political objective on our part in the war with Spain was to change the existing conditions in Cuba, and the military objective was the occupation of Cuba. The political objective of Japan in the Russo-Japanese War was to change the Russian status in Northern Corea and South Manchuria, and perforce the military objective was the occupation of these same places.

There may be other military objectives than those directly contained in the political objective, such as occupation of other territory, the interference with commerce, as by commercial blockade or commerce destroying or the raiding of outlying coaling or cable stations, but these are secondary, though useful, in so far as they affect the prestige of the enemy, his financial condition, and the terms of peace at the end of the war, and also as a discouragement to him to continue the war. Some of these secondary operations may have a direct bearing upon the primary objective, as when the coaling stations, though remote, yet affect the enemy's line of communications, or where commerce is interrupted to weaken the defensive power or spirit of the country the occupation of which is desired. In such cases, of course, they are in reality a part of the primary undertaking, however remote geographically they may be.

Again, these secondary operations may be prompted largely by secondary political motives, as where territory extraneous to the prime political objective is occupied in order that it may be retained at the conclusion of the war. In such a category was our occupation of Porto Rico, the Japanese occupation of Saghalien, and the Italian occupation of certain of the Ægean Islands. Such secondary political-military operations should not be undertaken if the military means for their accomplishment might endanger the success of the primary operations, and in any case they might better be deferred until the success of the latter seems assured; for a failure in the field of primary importance would make the re-occupation by the enemy in the secondary field most probable, thus only engendering additional humiliation, expense and loss of prestige.

Thus we see that the political motive for a war defines with reasonable clearness the military objectives of the war, and once

the war is declared the attainment of the political objective is dependent upon the attainment of the military objective, and consequently in the hands of the military branch of the government.

The military branch of a government is composed of two divisions, army and navy, whose ultimate object is the same; *i. e.*, the accomplishment of the desired political objective through the success of the final political instrument—war. It is the part that the navy has to do in the attainment of this desired result that is here discussed.

Since the two branches are striving for the same result it must follow that co-operation is essential. The campaign of each must be undertaken only with a view to the success of the war as a whole. The two arms are separate only because they operate on different elements, not because their aims are different. Wars are brought to a close primarily by the occupation and holding of territory, and a demonstration of ability to continue to hold. Mere defeats or victories themselves, on land or water, do not terminate wars, but the *consequences of defeat or victory do.*

A navy cannot physically occupy and hold territory, except temporarily, and consequently it cannot of itself terminate a war, however successful it may be. The army must make the consequences of a defeat of the enemy on the sea such as to make the enemy desire peace. The part, then, that a navy plays in war is to obtain command of the sea; the army must so utilize this command of the sea with other things as to bring the war to a successful termination. Command of the sea is not an end in itself, but only a means to an end.

It is not meant, of course, that a navy should not assist an army in every way possible to aid it in attaining its objective, as by assisting at and covering its landing, by bombarding fortified positions necessary to the success or security of the army, and anything else in its power that may advance the joint cause; but still the chief function of the navy must ever be to wage war on the sea, and this means to obtain command of the sea.

The most powerful army, once it is embarked in transports and at sea, becomes incapable of defending itself against even the smallest naval force; hence an army must have its way made safe for over-sea transport by its own navy. Of course, if the territory of belligerents is contiguous, command of the sea becomes of

less importance, but even in this case it may still be of great importance as affording a rapid route for an army to strike a remote region of the enemy's territory, or for taking in the rear or on the flank an opposing army occupying a strongly fortified frontier. In case there is no contiguous frontier, command of the sea becomes imperative, either in order that one's own army may invade or to prevent invasion by the army of the enemy.

It should be clearly understood that command of the sea does not give to the possessor additional military power, but only facilitates the application of power that without command of the sea would be rendered innocuous by the barriers of the sea confining it to its own shores. For example, take the case of Japan in the Russo-Japanese War. By obtaining command of the sea separating Japan from Corea and Southern Manchuria no additional power was added to her army, but that army was enabled to exert its power where needed in order to accomplish the purposes for which the war was waged. Without this command of the sea her army, however powerful potentially, could have exerted no influence in changing the Russian status on the continent, and the desire for a change in status there was the cause of the war. Suppose, on the other hand, Japan had possessed no army. Command of the sea in that case would have meant to her but a meaningless term, for it could not of itself bring any power to bear to change the Russian status in Manchuria. Thus, we see that command of the sea, while it is but one feature of a war, yet withal is of such vital importance that, in a war with an over-seas enemy, without it no real war-terminating blow can be either struck or warded off.

Remembering that command of the sea as a factor in warfare is not a meaningless condition, but a phase of war the utilization of which brings to bear on an enemy power that may terminate the war, the term must mean not command of the sea in a general sense, but of a particular sea or part of a sea. It is command of only those seas that can be utilized to further the use of force that has a bearing during war, for, as has been stated, command of the sea has not within itself any magic power to bring an enemy to terms, but it is the use to which such command is put that furthers belligerent operations. Of course, command of any sea prevents to a large degree the use of that sea by the enemy for commercial purposes, and by this means an enemy may

be annoyed, but scarcely brought to terms, unless it be in addition to command of the sea bearing upon the real political objective of the war. Had Russia been able to command all seas *except those adjacent to the Corean Straits,* the war with Japan would still have terminated just as it did.

Since command of the sea, as herein limited, is of such vital importance in war, it follows that naval efficiency of the highest degree is not attained without adequate knowledge of two things: (1) Where command of the sea is necessary, and (2) How it may best be obtained.

The possible enemies of any country are few in number, and potential causes of war are not numerous and should be discerned long before they develop into actual causes. Therefore it is comparatively simple to study in advance, in time of peace, every point that contains a possibility of war in connection with each nation that may be considered as a possible enemy. Every nation maintains certain doctrines and policies that conflict more or less with the interests of other nations, and no point that contains the possibility of a serious conflict of interest should be disregarded as a possible cause of war. In particular must it be emphasized that study of such questions should long antedate their seriousness. When a cause of war looms large on the horizon haste becomes a compelling factor, and the answers to the momentous questions as to where command of the sea is necessary and how it may best be obtained should be gotten from quiet and dispassionate study in time of tranquility, when may be carefully and accurately weighed, as well of one's self as of his enemy, military strength, actual and potential, its distribution, preparedness and efficiency, relations with other powers, other interests that may be put in jeopardy by war, financial condition, and the many other factors that bear on war. Then, when the hour of strain and anxiety attending the commencement of hostilities arrives, it should only be necessary to make such changes as the latest available information dictates to give the correct answer as to where command of the sea is necessary and the best method of obtaining it.

As to where command of the sea is necessary, each enemy has to be considered individually, but there are certain principles that govern in all cases. The seas, the command of which is useful in a war, are delimited by the geographical positions of belligerent

territory and the military objective or objectives of the war. In order that force may be brought to bear where it will accomplish the desired political result, certain lines of communication must be used, and consequently command of the seas containing these lines is necessary. The sea adjacent to the objective is of prime importance, for operations there are likely to be frequent or continuous, and control is correspondingly increased in importance. There may be more than one practicable line of communication, and where they are widely separated and cannot all be commanded, efforts should be concentrated upon the most important. A line may at some point pass through a narrow sea, and consequently at that point command becomes more important, particularly if it cannot be avoided by a detour. The relative importance of one's own line of communication and that of the enemy must also be considered.

The importance of lines of communication is too well recognized to need extended discussion. Some nations possess bases and stations extending to the farthest parts of the world, while others content themselves with less extended positions, but all have, or should have, a bearing on some possible line of communication in war. Some stations have a far-reaching influence, as Gibraltar, which may be said in certain cases to cover England's line from the western entrance to the Mediterranean to the Indian Ocean, since if she can control the straits of Gibraltar an enemy bound for India must make a detour around Africa. In a case of this kind the value of command of the sea in such a locality is emphasized. Other stations may not have so far-reaching an influence, but may cover some vital point, and here likewise the importance of command is accentuated. Each case has to be decided on its own merits, taking into consideration the enemy, the distribution of his forces and the military objectives in view. In a war between England and the United States command of the straits of Gibraltar by England would have no significance; in a war with Germany such command would protect widespread English interests, for it would not only mean command of the Mediterranean, but also practically command of all the seas to the eastward. In a war between England and France, if the French Navy were concentrated in her Atlantic ports, command of the straits by England would mean command of the Mediterranean, but if the French fleet were in her Mediterranean ports,

it would mean command of all the seas to the westward. Thus we see that in war with a certain enemy about a certain subject the command of a sea might be of paramount importance, whereas with another enemy its importance would be negligible; but the degree of importance of each sea in regard to each possible enemy should be determined before the need therefor arises, in order that from the very beginning of hostilities there be no frittering away of strength in useless undertakings and no delay in concentrating upon essentials, which would probably be the case were there any hesitancy as to where command of the sea was necessary.

After determining where command of the sea is necessary comes the determination of how to obtain it. Campaigns are characterized as offensive, defensive, offensive-defensive, and defensive-offensive, but there is just one criterion of a naval campaign and that is, "Does it obtain command of the sea where command is necessary?" It matters nothing how it be characterized if it fulfils this requisite.

In the campaign terminating in the battle of Tsushima the Russians may be said to have assumed the offensive, the Japanese the defensive, but the Japanese were in possession of that for which each fought, *i. e.*, command of the seas adjacent to the straits of Corea. The Russians must *come* and fight, while the Japanese had only to *remain* and fight. That alone was the difference between the offensive and the defensive.

There is just one way to get command of the sea and that is to fight for it. As to *where* to fight for it, again each case has to be judged upon its own merits. At Tsushima the Japanese were not only in possession of what they needed, but also that was the most advantageous place for them to fight for the maintenance of their command, because of nearby bases. It would manifestly have been a mistaken idea of the value of the offensive for them to have sought out the Russian fleet at some other point of their route, thereby surrendering an advantage which they held. The same holds true of the United States fleet in the Atlantic during the war with Spain. Command was necessary in the seas adjacent to Cuba, the political objective. This we had, and for our fleet to have sought the fleet of Spain at some remote part of the Atlantic would have been nothing less than offensive madness.

It is not meant that at some time it may not be advantageous to seek out an enemy's fleet far remote from the region where command is desired, but that it is so only when by so doing some commensurate advantage is gained. This advantage may be the assurance and confidence that the offensive may give, or to take an enemy unawares, or to conceal the ultimate campaign, but every move should have for its motive command of the sea in the particular locality where it is deemed most essential. The kind of campaign must depend on many things, but the relative location and status of the sea the command of which is desired must ever be one of the controlling reasons.

The test as to the correctness of offensive or defensive in any particular campaign is, "Which makes more certain command of the sea when finally the opposing fleets meet?" for meet they must if both really strive for command. If the defensive adds some factor that enables the defender to accomplish the desired result with more certainty, it is proper to assume the defensive; if the offensive wrests from the enemy some more important advantage, then it is correct to take the offensive. It is not the empty terms that count, but the compelling reasons behind them.

It should never be the desire merely to avoid a fight that impels the assumption of the defensive, but it should be the desire to enter the fight with some *additional* advantage. The defensive that consists of simply a passive waiting in the hope that something favorable may develop is always inexcusable. The defensive may be assumed with as ardent a desire to fight as the offensive, and each is properly assumed when it seems to offer the greatest chance of winning from the other the desired command of the sea.

It may sound anomalous, but it is true, that the offensive may be assumed with no desire to fight, but with the object of forcing an enemy to make a desired counter move. A case in point may be cited. During the Spanish-American War, Sampson had won command of the sea in the West Indies; Dewey had done the same in the Philippines. Now the Spaniards despatched a squadron for the Philippines via Suez, apparently much the superior of Dewey's squadron. Immediately our command of the seas in the Philippines was threatened. We could not reinforce Dewey from the West Indies before the probable arrival of the Spanish squadron, and for reinforcements to arrive late might subject us to defeat in detail. It is no secret what we did. We

ordered a squadron from the West Indies, not to the Philippines to fight, but to Spain, to cause the recall of the squadron which had just passed through the Suez Canal. The threat was sufficient, and the Spanish squadron returned, and our squadron did not sail.

Had the internal affairs of Spain been different she might have disregarded our threat, just as Japan refused to let her fighting ships be drawn out of the Yellow Sea by the raids of the Russian Vladivostok squadron. Despite popular clamor she kept her fighting fleet in the sea where command was necessary for military purposes. With the Spaniards internal affairs were deemed of greater importance, and the attempt to regain command of the Philippine seas was abandoned; with the Japanese continued command of the Yellow Sea was thought to be paramount, and popular clamor was left to spend itself as best it might.

Some power has to decide as to which shall receive recognition when interests conflict in war. Each interest seems of supreme importance in its own eye, and only the eye that sees all interests and can focus itself to see the result of each military move in the game of major strategy should be consulted when rival claims present themselves. The command of either of two seas may offer advantages; two lines of communication may be available when only one can be held; the security of one thing may be secured by the loss of another; a backward step may have to be taken that two forward steps may result. Some power must decide, and, other things being equal, that power will give the better decision that has fortified itself with long study and deliberation, with careful weighing of military factors, and with training to give decisions promptly and fearlessly.

Efficient individuals manning efficient ships combined into efficient squadrons make an instrument of war ready, responsive and potentially powerful, but above all is the efficiency of the user of the instrument; he who, weighted down with responsibility and burdened with care, yet directs and leads to the appointed place and in the fittest manner the energies and talents of his instrument. His is the power to plan and execute, but in order that the ultimate result may not fall short of his own success, the general features of time and place must be indicated to him. *What* is desired he must be told; *how* to acquire it should be left to his genius, buttressed by well-made and long-considered plans adjustable to circumstances.

Some directing power is necessary, that the burdens of the user of the great war instrument be lightened as far as may be by planning general features in anticipation, by indicating where the releasing of energy will return the largest national reward, and by considering and weighing in advance the many factors that enter into war. Whether this directing power be called general staff, general board, strategy board or division of operation of the fleet, is of no concern so long as it properly directs, for certain it is that the perfect instrument, the skilled user and the *prepared directing power* are alike necessary if naval efficiency is to be rewarded with that which is indispensable in war—command of the necessary sea.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE VENTILATION OF MODERN BATTLESHIPS.

By NAVAL CONSTRUCTOR R. D. GATEWOOD, U. S. Navy, and
SURGEON CHARLES M. OMAN, U. S. Navy.

A modern battleship is perhaps the highest type of concentrated mobile power yet developed by the mind of man, containing a greater variety of mechanisms than any other structure yet built. Yet all these mechanisms must be operated by man, himself largely a mechanism, and, in his functions aboard a man-o'-war, growing more and more like one.

For man to operate at high efficiency he must have air—good air—an lots of it, and there is perhaps nothing that can influence his efficiency so greatly, although this crying need for fresh air is sometimes carried too far. Professor Hough cleverly illustrates this phase of the ventilation problem by relating the story of the man who was unable to go to sleep in a hotel because he could not open the window before retiring, and who finally, in sheer desperation, threw his iron bootjack against the glass and broke it, after which he fell into a sound slumber which was undisturbed until daylight awoke him and revealed the fact that he had only broken the mirror which formed the door of his wardrobe.

The air in immediate contact with any man may be said to be his climate, and the effects of sudden variations of climate and temperature, even for a comparatively small number of degrees, are well known.

The old days, where the larger proportion of the crews found their daily work on deck in the open air, working with masts, yards, and sails, have now been entirely superseded by what are called "Modern Navy" days, where the larger part of the crew finds its work below decks with engines, boilers, dynamos, turrets, etc. Even in the old days much more ventilation was necessary than could be provided, but now the problem of ventilation plays an even greater part in the proper working of any ship.

Conditions have thus changed completely. Matters of ventilation are now largely those of engineering, and we are fortunate in being able to say that engineers are showing every possibility of adequately meeting the many demands of this very intricate problem. It is proposed, in what follows, to consider:

(a) What we would like to get.
(b) The difficulties in the way of getting it.
(c) The aids by which we may expect to get it.
(d) Methods by which we undertake to get it.

In considering, then, this vital and interesting feature of a modern battleship, what are the demands? What are the desiderata in any system of adequate ventilation?

DEFINITION OF PROPER VENTILATION.

A satisfactory system of ventilation must provide a continuous, and, more or less systematic, renewal of air in the various spaces of the ship by properly distributing a fresh supply of pure air in quantities sufficient to make up the deficiency in oxygen caused by the breathing of the occupants and the combustion in the furnaces, and to remove, or, at least, to sufficiently dilute, the overheated air, the products of combustion, and the gaseous materials thrown off by the occupants and the stores of the vessel. Moreover, the above must be accomplished by furnishing comfortably dry air, free from disagreeable drafts and of an even temperature, and the compartment should be free from odor. Such are the requirements of a perfect system of ventilation on shipboard.

DIFFICULTIES TO BE MET.

The requirements for good ventilation on shore are not greatly different from these, and yet how few well ventilated buildings are there in the world? How much more difficult is it then to meet such an array of requirements on board ship? For the purposes of ventilation a battleship may be considered as a hollow spindle-shaped body, one half submerged in an ocean of water, and the other half in an ocean of air, and divided by horizontal partitions or decks, and vertical partitions or bulkheads, into hundreds of small spaces. Many of these, such as those containing engines, boilers, coal bunkers and stores, cannot be furnished with any side openings, and many of the openings that it is possible to pro-

vide, such as air-ports and gun-ports in the side above the water-line, and hatches in the decks, must necessarily be closed at sea in rough weather. In fitting all these openings they must be designed with a view to the use of the ship as a fighting machine, and it is not possible to fix even the position of such important things as ventilators in accordance with the requirements for the best natural ventilation on account of such considerations as the position of guns, strength of structure, etc. Moreover, the vessel itself is entirely a metal structure and therefore an excellent conductor of heat. Its sides are not porous, as are the walls of a house. The deck heights are necessarily low and on account of the military requirements as to the large number of men necessary to operate the machinery, guns, and other mechanisms on board, it is quite out of the question to provide anything like a theoretically adequate cubic space per man on a battleship. Then, too, a battleship being entirely a compromise as to its features of design, it is only possible to provide a certain amount of space and to allow only a certain amount of weight for its ventilation. Such are the difficulties to be encountered.

AIDS TO VENTILATION.

In attempting to solve any engineering problem the first consideration of the designing engineer is to utilize all of the natural forces which can be brought into play, and in the matter of ship ventilation the force of gravitation is a great salvation. Nature has provided a constant force, resulting from the difference in weight of a column of warm air and a column of cold air. It is this force and that fact that the air surrounding the ship under nearly all conditions is of remarkable purity, that make it at all possible to attain any considerable degree of success in this matter. Fortunately, too, the tendency of most of the improvements in all the latest designs seem to aid in removing some of the burden from the ventilating engineer.

For example, the use of electric lights has been an enormous aid, as they add a comparatively small amount of heat, and consume none of the oxygen in the air. For purposes of convenience in handling stores and ammunition in the latest ships, all the hatches are vertically one above the other, which, as can readily be seen, is a very material aid in effecting a strong "tendency." The new ships have a much higher freeboard and it is possible to pro-

vide therefore more cubic feet of air space per man. The latest engineering practice requires all steam piping and other sources of heat to be carefully insulated for the purpose of economy from an engineering point of view, but this also aids greatly in reducing the effect of the necessarily large number of heat sources in the ship. The newest ships are to have electric anchor engines and steering engines, and it will not be necessary to carry throughout the length of the vessels long lines of supply and exhaust steam piping that heat up not only compartments through which they pass, but the adjacent compartments. Also the latest researches seem to indicate a very helpful feature in pointing out the interesting fact that a powerful *circulation* of the air in a compartment can produce results equivalent to a considerable *supply* of air, even though no air is actually supplied to the compartment.*

*In this connection, the following is quoted from *The Medical News:*

"The way to keep air best, from the physiological point of view, is shown by the following experiment performed by Hill at the London Hospital: Into a small chamber which holds about three cubic meters he put eight students and sealed them up. They got into the chamber joking and lively. At the end of half an hour the wet bulb temperature had risen to 85° F. They ceased to laugh and joke and their faces were congested; the carbon dioxide had gone up four or five per cent and the oxygen down to a corresponding extent. Hill then put on three electric fans and merely whirled the air about just as it was. The effect was like magic; the students at once felt perfectly comfortable, but immediately the fans stopped they felt as bad as ever. In another experiment a man in a chamber breathed through a tin of soda lime so that he got no carbon dioxide. When the wet bulb temperature rose to eighty-five degrees sweating and discomfort came on, just as in the first experiment, and when the fans were turned on he got the same relief. Then a bag containing carbon dioxide was connected with the chamber and enough of the gas was admitted to raise the percentage of carbon dioxide to two per cent. The man in the chamber felt no ill-effects whatever and even did not know that the gas had been admitted, but he was observed to breathe more rapidly. These experiments, Hill asserts, show that all the discomfort from breathing in a confined space is due to heat and moisture, and not to carbon dioxide. Even after forty-five minutes in the chamber there were no after effects, such as headache. In a crowded room the air is at the body temperature and there is no circulation; therefore it becomes saturated with moisture and we have no means left of keeping the body tempreature down. We cannot radiate heat because we are of the same temperature. We cannot lose heat by evaporation because the air is entangled among our bodies and cannot get away. Then the heat-regulating mechanism is strained and in order to keep the body temperature down the heart has to beat very much faster and we feel miserable, but as

It is thus seen that there are many real aids as well as the equally real difficulties, but before we can intelligently consider the forces available for moving the air, we must understand something of the physical properties of the air, and also the sources and materials of its contamination.

PHYSICAL PROPERTIES OF AIR.

The composition of ordinary air as supplied through the ventilation systems of a ship is, by volume, as follows:

Nitrogen	79.00	plus water vapor.
Oxygen	20.96	
Carbon-Dioxide	00.04	

Perhaps the two most important of the above constituents are the carbon dioxide and the water vapor.

The water vapor content of air should be considered as an entirely separate feature, in the same manner as the air content of water would be, as it is not an essential part of the air proper. Exactly as water before it is aerated is not suitable for drinking, so air without water vapor is not suitable for breathing. We are perhaps more affected by small variations of the water vapor content of air than by any other one ingredient. It is moist, warm air that prevents the removal of heat from the body by evaporating the perspiration, and it is the moist cold air that so quickly deprives the body of its heat by convection. Also very dry hot air irritates the skin and membranes of all the respiratory passages by a too-rapid evaporation of the moisture from their exposed surfaces.

For many years all ventilating systems, both on shore and on ship, were designed to furnish air in such quantities that the carbon dioxide percentage should never be above .07 per cent, and it was long believed that the carbon dioxide acted directly as a poisonous agent. It is not, however, a poisonous gas, but it has a smothering effect and stops the process of oxidization. It is now commonly regarded as a measure of the intensity and concentration of the substances thrown off by man through the medium of the lungs and the skin, and it is these substances, which constitute the

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soon as the air is made to move relief is given. Mr. Leonard Hill concludes, therefore, that when it is not possible to keep the air of a building up to the chemical standard of purity laid down in the text books, the proper course is to keep the air moving."

most poisonous constituents of the air that we breathe. It is the contained air of the ship, not the entering air, that gives us pause.

SOURCES AND MATERIAL OF CONTAMINATION.

From a hygienic point of view the most undesirable feature of the air found on shipboard is its high temperature. This heating of the air is largely unavoidable on account of the large number of heat sources on board and the fact that the vessel, being of metal, readily conducts the heat of the sun. A considerable quantity of the heat generated is wasted through the exposed surfaces of bulkheads, pipes and machinery, and it is this so-called "wild-heat" which it is necessary to reduce to an absolute minimum. Many confuse heat and ventilation and do not understand the all-important point that it is the combination of the two that gives all the trouble.

This "wild-heat" is not only undesirable of itself, but produces harmful draughts, and the so-called "sweating" of the metal of the ship's structure. The shell-plates of the vessel are in contact on their outside with cold sea water and on their inside with warm air. The air in immediate contact with the inside of the shell-plates being much cooler than the surrounding air on account of the fact that the metal so readily conducts the hot air from it into the cold water, allows its water to be condensed and deposited on the inside surface of the shell. This water is, of course, very undesirable from point of view of corrosion of the metal, but it is also a highly undesirable thing from a hygienic point of view, because it is actually *largely water derived from the exhalation of the lungs and skin,* and should have been carried out of the vessel by the system of ventilation. It is spread over a very considerable area, and it is available for taking up other organic material which may be suspended in the air that comes in contact with it.

Battleships contain a very large amount of sheathing designed entirely to reduce the amount and the effect of this "wild-heat." At first wood sheathing was used, and this was only applied in officers quarters. On account of its inflammability, wood is, of course, highly undesirable, and now light metal sheathing is used, having its interior side cork painted and further insulated by means of slabs of cork, usually about 1½-inch thick. Asbestos sheathing is also used, and in some places cork paint. This last, however, is not satisfactory, as it is quite expensive to apply and not as

efficient as sheathing nor as satisfactory from a hygienic point of view, as it does not present a smooth, dust-proof surface.

Air spaces for insulation between bulkheads and decks are much more frequent than in the older ships. Where the air space is small, say from six to eight inches, circulation of air is not usually provided, but where the air space is large, as, for example, over the boiler room, where it is sometimes twenty-four inches deep, a regular supply and exhaust system is fitted for such a space. Fire felt, magnesia, linoleum, and several other patent insulators are used in addition to the above, and the whole subject of the reduction of this uncontrolled heat has received very careful consideration on the part of the designers.

In addition to the temperature, the air contained within a vessel is modified by the nature of the stores on board and by the men who are on board. The modification affected by the men can best be appreciated by stating that a crew of 1000 men actually add by way of the lungs to the contained air of a ship some 2000 pounds of carbon dioxide per day, of which 560 pounds is carbon. In the same way they add about 620 pounds of water. Now, experiment has shown that expired air contains about 5 per cent less oxygen than inspired air. After breathing by 1000 men the contained air of a ship will thus actually contain some 16,800 cubic feet less oxygen than it did before it was provided. Through the skin the average man on board ship adds to the air about two pounds of moisture per day. A crew of 1000 men would thus add nearly a ton of moisture in this way, and of this amount eleven pounds would be solid material.

FORCES AVAILABLE FOR MOVING AIR.

Natural ventilation may be defined as that ventilation which does not require the use of machinery. It is caused by the action of the wind, by the natural diffusion that takes place between currents of air, and by the difference in weight of air at different temperatures. The action of wind is very powerful, but unfortunately is entirely undependable, and therefore can be relied on but little for a battleship. The question of diffusion is a most important one, and this importance is not always appreciated by those concerned in the designing of ventilating systems. In the first place, all compartments furnished with supply must also be furnished with means for exhaust, and vice-versa. This may seem a

truism, but there are instances even on our latest ships where this principle has not been followed out and compartments are furnished with a supply and not adequate means of exhaust. In the second place, the designer is often largely concerned with supplying a certain *volume* of air to a compartment, and is not so greatly concerned as to the method of distribution of this air in the compartment. It is not so entirely a question of the supply of air as is generally supposed, but also very largely one of proper *diffusion* or *circulation* of air.

The great importance of this feature has only been brought out comparatively recently by a number of other experiments similar to Dr. Hill's above mentioned, the results of which, in brief, are to the effect that it is possible for man to work in an absolutely-closed compartment, provided air in that compartment is kept circulating by means of numerous fans, for a longer time than if a small supply and exhaust were provided. It is believed that the results of these experiments will be of considerable value in connection with providing suitable ventilation for such spaces as central stations, conning towers, and other small important battle stations into which air is now drawn from supply pipes into which smoke would be drawn in case of action. There is no doubt that the present unsatisfactory ventilation conditions in certain fire and engine rooms would be very largely overcome by supplying a large number of ordinary circulating fans for these compartments. It is not so much the heat in the engine-rooms that knocks the men out as it is the fact that the air is not kept circulating.

A most interesting experiment in connection with the engine-room ventilation of the U. S. S. *North Dakota* was conducted by Surgeon F. L. Pleadwell, U. S. Navy, and the following is quoted from his report of the results:

> Briefly, the conditions which prevailed in the tests were those of a closed space in which the temperature was far above that of the body, and with a relatively high degree of humidity for this temperature. The temperature was not constant, for extensive surfaces were radiating heat into the closed space and means for heat or escape of heat were almost eliminated. There was no air movement, since ventilation was stopped in order to simulate an assumed battle status, namely, that to be described later, where noxious gases and smoke surround the ship and necessitate an interruption of the ventilation. Within a few minutes after starting the test symptoms of loss of heat balance were observed. The pulse rate rose, there was a fullness in the head, a decided feeling of discomfort and oppression, headache and dizziness, and after emergence from the engine room several individuals

showed a decided rise of temperature. Subsequently headaches and a feeling of extreme physical exhaustion were noticeable. There was no dissent from the opinion that serious results, if not complete disability, would have followed if the test had been persisted in for long. It was clearly demonstrated that some special provision must be devised to meet this emergency of battle, even if it is only of a temporary nature, serving to tide over a critical period of short duration. What may happen in a naval engagement when ventilated compartments below deck are overwhelmed by smoke and

	First Experiment, March 9, 1911 (no circulation)	Second Experiment, January 22, 1912 (circulation)
Outside temperature—		
Dry bulb	78	92
Wet bulb	73	88
Barometer	30.00	30.08
Rel. humidity	79%	85%
Wt. Ag. vapor in grains.	8.222	13.316
Engineroom temperature—	(1.17 p m. to 1.35 p. m.)	(1.30 p. m. to 1.45 p. m.)
Dry bulb	110–106	126–128
Wet bulb	.....	105–108
Barometer	.....	30.08
Rel. humidity	.....	49–52%
Cubic capacity by engine room force.	3100 per capita (6 persons)	3100 (CO_2 at end of 1 h.=2.3+4=6.3 pts. per 10,000).
Condition of inlets and outlets.	All closed	Closed in the main.
Ventilation	Stopped	Running (air renewed every two minutes).
Condition of personnel.	Considerable degree of physical discomfort; fullness in head; nausea and dizziness; complaint of "stagnation of air;" material accelleration of pulse rate and rise in body temperature.	Only moderate discomfort; slight rise in body temperature.

powder gases has been largely deduced from the observations recorded in the rather meager accounts of the naval engagement of the Russo-Japanese War, but some of these accounts are sufficiently detailed to indicate that a ship against which a shell containing high explosive may burst, or whose smokestacks are perforated, remains for some time enveloped in an atmosphere of smoke and noxious gases, which, being drawn into the ventilation systems, are delivered with the air supply to compartments below in sufficient concentration to imperil the efficiency of the personnel there, if they do not absolutely overcome them. . . . .

All individuals presented a much accelerated pulse rate, and in several the body temperature rose to a point several degrees above normal. In one individual the rise was as much as 3.4° F.

The following changes in pulse rates were noted:

Beginning of Test.	*Termination of Test.*
100	162
98	144
98	132
80	140
82	132
84	168

In the limited time elapsing before the conclusion of the experiment, only 18 minutes, but few observations were practicable, and such as were made had, of course, to be made upon men actively engaged in their usual duties and amid the noise and confusion of moving machinery.

Natural ventilation is only relied on *entirely* for spaces within the superstructure and the deck erections above the main deck. It is, however, relied on to a very large extent, for gun and main deck spaces and for lower coal bunkers. Natural ventilation is obtained for the lower coal bunkers by leading pipes from the lower bunker to the uptake enclosure. The hot air in the enclosure tends to rise and draws with it the air from the lower bunker, fresh air coming into the lower bunker through the doors in the fire-rooms. These pipes from the lower bunker must be fitted with a damper to prevent the pressure in the boiler room from being lost when steaming under forced draft. From the upper bunkers an artificial supply and a natural exhaust are fitted.

Artificial ventilation has come to mean ventilation by means of fans. It may be divided into two systems; the supply or plenum system, and the exhaust or vacuum system. When it was first provided on battleships the system considered as most efficient was that involving several large steam-operated blowers connected with large ducts carried throughout the length of the ship with numerous branches. The steam leads to the blowers and the blowers themselves constituted an undesirable source of heat, and friction in the long leads of the ducts greatly reduced the efficiency of the system. Also, it was impossible to provide those spaces at the ends of the leads with sufficient air, for the reason that the spaces nearest the blowers took more than their share. This system has since been replaced by a number of independent ventilating sets, consisting of fans operated by electric motors.

The fans first used were of the propellor type, but recent improvements have brought about the introduction of fans somewhat similar in their action to that of a paddle-wheel, which are known as sirocco or multivane fans.

In early ships the exhaust system of artificial ventilation was almost exclusively used. It was found to be highly inefficient for the general ventilation of a battleship and a combination of the two systems was then tried. Little by little ventilation systems have come around to a system involving almost entirely a supply system except for those spaces such as dynamo rooms, engine rooms, etc., which require both supply and exhaust.

METHODS EMPLOYED TO MEET THE ABOVE DEMANDS.

The following outline will serve to show the care used in designing a suitable system of ventilation for a battleship. The methods employed are not only the result of a thorough consideration of all the points considered above, but in addition there must also be taken into account the ordinary number of occupants of the compartment and the character of the activity of the occupants.

Until recently, the amounts of air supplied to a given compartment were based on a factor known as the " rate of change "; that is, the amount of air was based on changing the total air in the compartment once in a certain length of time, which varied from one to thirty minutes. This " rate of change " was determined from experience on all the battleships thus far constructed, and just here, let it be stated, that in ventilation, as in all engineering, previous experience must be largely relied on and referred to.

The present practice is to investigate the quantity of air required for each compartment, based on the rate of change as determined by experience for similar compartments in previous vessels, and simultaneously investigate the amount of air required, based on the number of occupants of the compartment and the character of the work customarily performed in the compartment. From these two that one is selected which calls for the larger amount of air. This quantity is further modified as considered necessary by reason of proximity to excessively hot compartments or to the outside plating of the ship. The following examples may be cited of the above practice.

In the case of a single stateroom the average capacity of the room may be taken as eight hundred cubic feet. The rate of

change which has been found to give satisfaction is about ten minutes. At this rate eighty cubic feet per minute would be required. The amount of air per man required to maintain practically fresh air may be taken as forty-five cubic feet per minute, which assumes continuous occupation of the compartment for long periods. In such a case the larger of the two quantities, eighty cubic feet per minute, would be used. If the stateroom adjoined machinery hatches, dynamo trunks, or other hot spaces, this amount might be increased to one hundred, or even one hundred and twenty cubic feet per minute, or, if the stateroom were in a particularly exposed condition, the same increase might be allowed.

In the case of engine rooms, dynamo rooms, distribution-board-rooms, central, sub-central, and similar compartments, the rates adopted are the result of experience, and the air supplied is primarily for maintaining proper working temperature, the amounts being very much in excess of what would be required to supply fresh air to the personnel ordinarily occupying these compartments.

The ventilation systems for engine-room and fire-room compartments are quite a study in themselves, and are designed entirely independently, based largely on experience with previous ships. Although they form a very large proportion of the total amount of ventilation of any battleship, details will not be here entered into.

As soon as the deck plans of a vessel, showing all compartments, have been developed sufficiently, the capacities are calculated. An approximation is made as to which compartments will be grouped in the various systems, and the approximate number of systems is determined. The amount of air required for each compartment is then determined, as described above, and a suitable number of compartments are assigned to a given system. After this has been done a suitable engineering margin is added to the amount required to be supplied to each compartment (usually 10 per cent), which is to allow for inequalities in the distribution of the air from the fans. The capacity of the fan for each system is thus obtained. The above applies particularly to systems supplying living spaces, storerooms, magazines, handling rooms, etc.

From the information thus developed the type plans of ventilation are prepared, showing the locations of all fans, leads of mains

and branches, and the nominal quantities required to be delivered at each outlet, which, as stated, are a certain amount in excess of the quantities actually needed. These plans are issued to the builder of the vessel to be used in developing the detail plans of the systems.

In laying out the detail plans of ventilation piping, the size of mains and branches, and the pressures and velocities of air, are based on certain standard instructions issued by the Bureau of Construction and Repair as the result of extensive experiments conducted by Naval Constructor Taylor at the Experimental Model Basin, Washington, D. C.

VENTILATION OF THE U. S. S. WYOMING.

This ship is ventilated by what is termed the "direct contact and ventilating system," which, in a manner, describes itself. The heating and ventilation of a compartment or space is obtained by means of a common duct. This system was first tested in our navy on the U. S. S. *Vermont* in 1906, and has been extended to all ships since the *Utah* class.

In general, the system consists of thirty-four separate fans, including exhaust and supply. Air is drawn in from numerous mushroom cowls, ventilators and trunks, located on the main and superstructure decks. Distributed over the third deck are twelve "thermo-tanks," forming part of the air ducts themselves. A "thermo-tank" is merely a collection of steam coils over which the air must pass before it is conducted to the various parts of the ship. There is a damper in each "thermo-tank," which provides for the certain regulation of the flow of air and for securing a greater or less degree of temperature. The combined system is not carried to the storerooms or other places where heat is not necessary, outside air alone being used in these places. The piping is so arranged that the temperature may be controlled through a part of its range by regulating the proportion of cold air and heated air, and through the remainder of the system by regulating the heat.

The advantages claimed for this system are that it permits the regulation of the temperature to a uniform degree. It saves weight and wall space by doing away with the old radiators; it prevents the accumulation of dirt and dust; is economical of fuel, and does away with the disagreeable noise caused by the water-

hammer in radiators. The branch ducts are led away from main with an acute angle, and are comparatively small in diameter near the main, but gradually increase like a funnel, the design being to give the greatest amount of air with as little of the ringing noise and draft as possible.

Following are the most important defects on this ship, many of them having already been corrected in future designs.

The main objection (which may also apply in a greater or less extent to any system of heating) is the relatively low humidity of the delivered air. The necessity of more moisture is apparent in this system, and has been the subject of much comment. Officers have frequently complained of the dryness of the air, causing a feeling of fullness in the head and a dry nose and throat. Some form of humidifyer should be installed in future systems, and, if possible, should be fitted to the present system. The ordinary means frequently employed on shore, which automatically wash, heat, and humidify the air, are somewhat too heavy, complicated, and expensive for use on shipboard. The problem is not an easy one, as the humidifyer must be small and it must not so saturate the air as to cause corrosion of the air ducts.

In the ventilation of quarters forward large air ducts run through some of the staterooms abaft the ward-room, then through the ward-room to the staterooms forward of the ward-room. This air duct abaft the ward-room becomes so warm that it in itself is almost enough to heat certain rooms. Therefore, in heating the forward rooms to the desired temperature, the after rooms become too hot if the louvers are left open. But turning off the louvers turns off the supply of air. It would be possible to rectify this by having the main ducts lead through the passage-ways. This, however, occupies valuable head room and it is much preferable to lead the ducts in the otherwise unused space between the outboard side of the staterooms and the deck overhead.

Numerous officers have expressed their opinion that they prefer individual radiators as a means of heating their staterooms. The objection to radiators in general are the expense, weight, places for the accumulation of dirt, and space occupied.

The whole subject of heating ships is in itself sufficiently large to form the subject of any paper, and, in order to keep the question of ventilation within reasonable bounds, the matter of heating,

even though it is more or less intimately connected with ventilation, will not be entered into here.

Supply ducts are overhead. It would, of course, be desirable to deliver hot air at the bottom of a room, and cold air at the top, but although considerable inconvenience results from thus delivering hot air at the top of the rooms, when we consider the comparatively short length of time that it is necessary to supply hot air to the rooms, it is not believed that the extension of additional pipes to the bottom of the rooms would be warranted.

The sick quarters are well ventilated by both supply and exhaust. It is suggested, however, that the exhaust from the isolation ward be separate from any other system. On commissioning this ship had a supply duct leading into the operating room, but this was immediately cut out, and a single brass steam radiator installed. It was found impossible to heat the operating room on short notice, and the amount of dust and dirt which came through the duct was very dangerous and objectionable.

The third deck is well ventilated except in certain compartments aft occupied by the marines and the fire-room force. The system is supply, and it would seem that somewhat more supply is necessary for diffusion.

Storerooms are well ventilated by supply, there being no artificial exhaust.

The engine-rooms and fire-rooms are well ventilated.

The crew's heads are well ventilated by exhaust.

The dynamo-rooms are poorly ventilated, owing to insufficient exhaust, but this is to be remedied by supplying a large exhaust fan.

The steering engine-room is poorly ventilated, but this also is to be remedied by supplying an additional exhaust fan.

The servants' wash-room has only a supply. An exhaust is needed.

A few small exhaust pipes in the magazines open into the space on the third deck. This is not desirable.

There are a few staterooms on the port side which are very uncomfortable during hot weather or when underway, but this is due more to location near heat sources than to lack of ventilation proper.

The point of exhaust seems to be bad at times. On this ship the exhaust from the warrant officers' water closet comes out

on the main deck about three feet forward of the supply which carries air to warrant officers' rooms and to sick quarters.

On account of the change in boat stowage the fire-room ventilators are masked by the boats, thus greatly reducing their efficiency. This defect will be remedied at the next visit of the vessel to the yard by lengthening the ventilators.

Generally speaking, the results on this ship are very good and it would seem that this scheme of ventilation and heating combined is the right one. There have, however, been a number of individual complaints, but some of these criticisms are based on unusual or the worst conditions which are actually of infrequent occurrence.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE BOATSWAIN'S CALLS.

By CHIEF BOATSWAIN STEPHEN MCCARTHY, U. S. Navy.

In compliance with the request of the editor of the PROCEEDINGS, I submit the following description of the calls and pipes used by the boatswain and his mates in the days of sail and steam.

The call, as we term the instrument,[1] is divided thus:

Few or no calls issued are shrill enough in sound to suit the men who use them, and each user of a call has his own method of tuning his call to that shrill note required in nearly all the signals used.

Most calls are too open at the pee and have to be flattened or soldered at the sides of the pee, so as to fill the space between it and the bowl.

Some calls are improved by scraping the wind edge or edge of the bowl furthest from the pee. It is sometimes necessary to enlarge this hole by scraping as well as by sharpening the edge until the reed strikes the hole fair. A test of this is often made by pushing the large end of a broom straw through the reed to find how the straw hits the wind edge of the hole. That edge of the hole should split the straw. The call once tuned should sound if held with its mouth to a gentle breeze, and, when blown on with open hand, should sound from the most repressed pressure to the full strength of the lungs without any flaw in the sound known as wind leak, or hoarseness; and the sound with closed hand should be as clear and shrill as it is possible to make it.

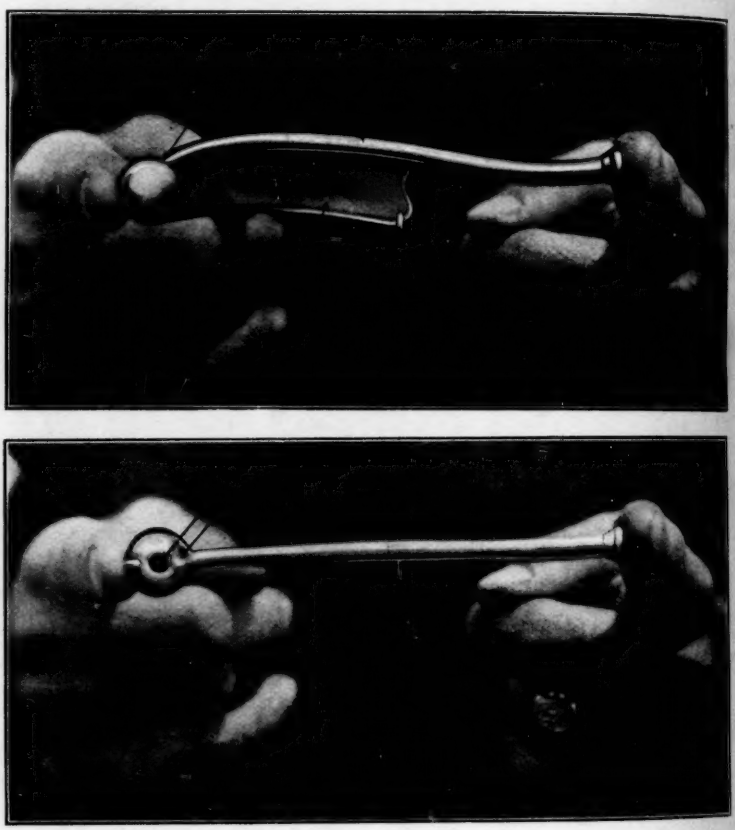
In the following description of notes, a straight line will indicate smooth notes.

[1] The nomenclature here given is slightly different from that of the Navy Specifications, but is according to the language of the sea and is therefore used.

Dotted lines will indicate the rattled notes.

Broken lines will indicate undulating notes.

Smooth notes are made as any ordinary whistle is blown and simply raised or lowered by the lung force used.



THE BOATSWAIN'S CALL.

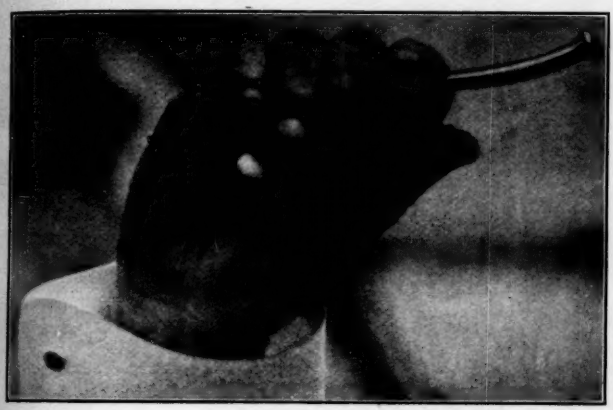
Rattled notes are made by the ballarding of the tip of the tongue against the roof of the mouth, imitating a whistle rattled by a pea.

Undulating notes are made by a combination of the tongue slightly undulating while the throat checks the lung pressure or flow of breath, causing the sound to undulate smoothly, but continuously, at equal intervals.

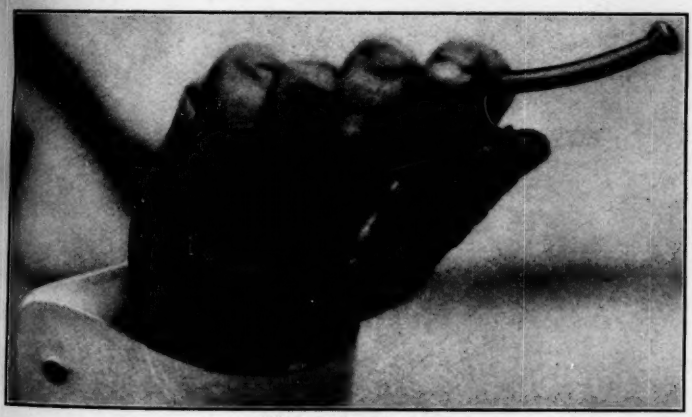
There are four positions of the hand, viz: Open, curved, closed, and clinched, which are indicated on the four spaces of a musical score, thus:

Clinched
Closed
Curved
Open

and are shown in the following plates.



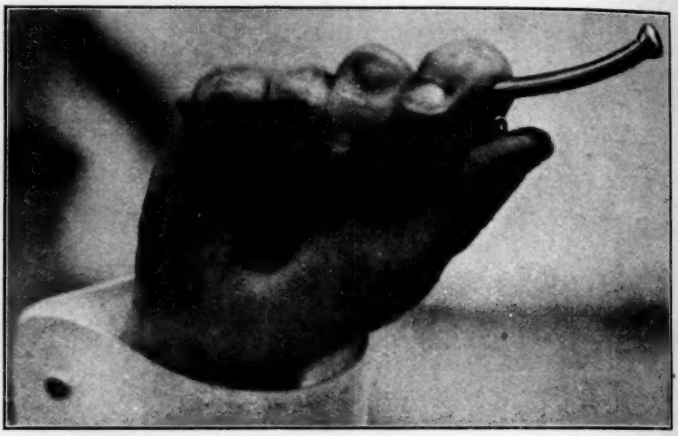
HAND OPEN.



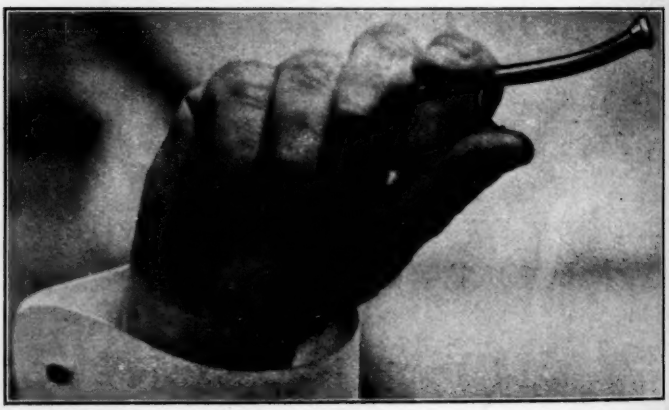
HAND CURVED.

These positions also indicate the lung force or pressure of blowing. As a rule the open hand calls for the least pressure

required to make a soft, clear note, while the clinched hand calls for all the pressure that can be used in making the note shrill and clear.



HAND CLOSED.



HAND CLINCHED.

Intervals, or rests, are marked thus "/" with the numeral of the seconds above if more than one second is necessary; otherwise, notes are slurred smoothly.

The number of seconds each call should have under normal conditions is marked above the bar, but circumstances often call for the signal to be shortened.

Tradition and old navy customs made the calls, belays, and other signals long or short, such as I may instance in the difference between calling away the dinghy and the barge; and the boatswain's mate who gave the length of call to the dinghy that he gave to the barge, either by pipe or voice, was not up to the standard and was soon checked for his mistake. In like manner, in the piping of dignitaries alongside and over the side the call was lengthened in proportion to the rank, though the Admiral was always honored with the full breath of the side tender, even though others might rank more side boys. Short side calls were always frowned on as disrespectful as well as lubberly. Therefore, there was a certain fitness that could not be resented.

To illustrate more clearly, there was a certain chief boatswain's mate, noted as much for his yarns as for his good seamanship, who made a brag of once piping Admiral Farragut over the side bursting his call and killing two of the nearest side boys.

Tones of voice in the passing of words were modulated and pitched as the occasion called for, such as the rising inflection on "Up all Hammocks," and the lowering inflection on "Down all Bags," or "All Hands, up Anchor for Home" and "All Hands Bury the Dead."

In all cases where all hands were to be called for either an evolution or a function, the boatswain received the order from the executive officer, the officer-of-the-deck or a messenger; but the latter course was seldom the method in a taut or smart ship, and the boatswain usually received his orders for all general calls on the quarter-deck.

For such evolutions as make, shorten and furl sail, up or down light spars, moor or unmoor ship, the procedure was about like this:

Executive to Officer-of-the-Deck, "Send for the boatswain, sir." Officer-of-the-Deck to messenger, "Tell Mr. B. to lay aft." Executive to B., "Call all hands to make sail, sir. "Aye, aye, sir." Executive to Officer-of-the-Deck, "I will relieve you, sir." Officer-of-the-Deck turns over the deck and goes to his station for the evolution. B. walks smartly forward towards fore hatch sounding the call for mates. Mates answer and gather around B. When all are present B. says, "All hands make sail" and immediately commences the call on the pipe with the mates and the order

"ALL-HANDS-MAKE-SAIL" is sung in a long-drawn chorus with B. leading the chorus as he led the piped call.

The boatswain then took his station on the forecastle and his mates took their stations, the mates of the lower decks shouting "Up the Fore Hatch!" "All up from Below!" when that deck was cleared, except of the men stationed there, and the boatswain expected that to be done promptly, even though there was a watch below turned in, and he did not hesitate with "Move Lively" to the laggard; for the time of the evolution was often taken from the instant all hands were called until pipe down, though the general rule was to take the time from "Aloft topmen" to "Down from aloft" and those slow in obeying the "Down from aloft" were stood up to have their names taken on a report of slow in obeying orders, or if the evolution was not made within the allotted time, it was repeated as a rule. I do not wish to elaborate further, for to cover all the customs and traditions might not be of interest, so I will let the foregoing serve as an illustration of the manner of passing a common call of "All Hands," and all understand that the order "Pipe Down, Sir" came in a hail from the Executive to B., that B. answers "Aye, aye, sir," and again chirps to his mates who answer him from their stations, and then follow him in the call for pipe down. No word is passed with this call which is general.

In special pipe down calls, such as "Down all Bags," the word was passed in singing tones, "Down - all - Bags."

In the days of sail alone, all hands were called to evolutions as every man had a station on deck.

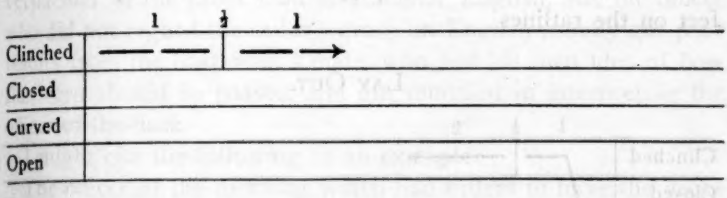
In the days of steam and sail the engineer's force on watch were excused from deck evolutions while steam was on the ship, but 48 hours after hauling fires all the engineer's force reported to their stations on deck, except for cleaning stations after breakfast, and the word "All" was omitted, so that the call became "Hands Make Sail," and later "Hands" was omitted, and the call became "Make Sail," etc. So that the word "All Hands" was used only before such calls as "Save Ship," "To Muster," "Bury the Dead," "To Quarters," "Abandon Ship," and the old "All Hands Up Anchor, for Home" was retained out of sentiment to the breaking of the homeward-bound pennant on leaving the last foreign port after a cruise of at least two years on a foreign station

with the prospects of the ship going out of commission as soon as she reached home, and the crew to be scattered or discharged.

At the long, sharp call for "Attention," followed by the words "D'ye hear there," all hands listened for the word to be passed, and the talker, singer, or skylarker, who asked, "What word was passed," did not let the man who passed the word hear him, and the delinquent who did not hear the word passed offered an excuse that usually added to his offense.

For those were the days of discipline, the sea lawyer was the butt of the ship, fore and aft, and the tail did not wag the dog. "Growl you may, but go you must," was the sailor's motto.

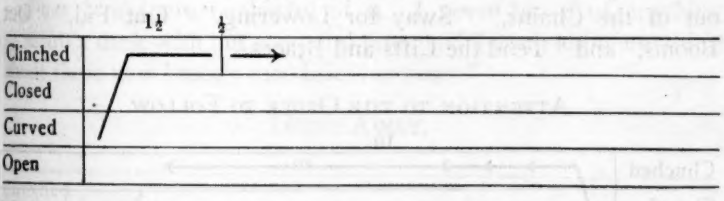
CALL MATES.



Call in clinched position and sound as "peep peep," "peep peep," short and shrill with a pause of less than one second after the first two peeps.

This is answered by all the mates as they close on the point of assembling to receive the order to be passed from the boatswain or his chief mate, who blew the signal.

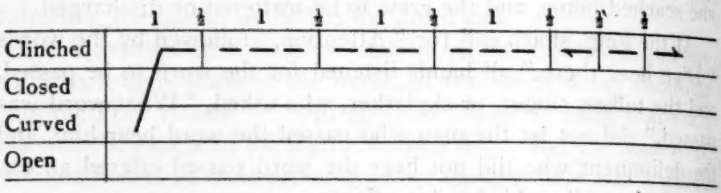
STAND BY.



Commence with the call in the curved position and instantly change to the clinch, causing a rising peep, and follow it with a slurred peep, short and ending sharp.

This signal is used for "Set Taut," "Stand By," "Hold Fast," "Lay In," and as "hip hip" before a Hurrah in cheering ship.

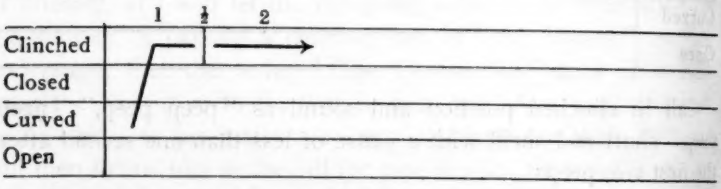
ALOFT TOPMEN.



Commence as in "Stand By" and follow the long peep by a series of three sharp peeps with an interval of about one second between each series of peeps, and slow down the last three peeps to about equal intervals between them.

This signal is shortened for "Aloft Light Yardmen" and "Lower Yardmen" and the peeps should time the patter of the feet on the ratlines.

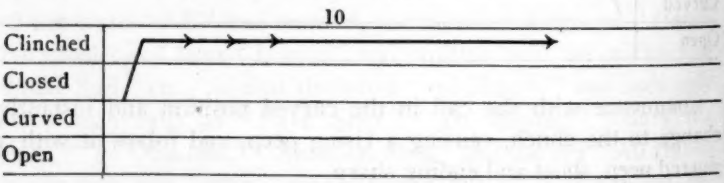
LAY OUT.



As in "Stand By" excepting that the first peep is but about half the length of the second one and is pitched higher on the start. The interval of time is about the same as the verbal order, and in fact should be so timed.

This signal is also used for "Break Stops," "Trice Up," "Sway out of the Chains," "Sway for Lowering," "Out Fid," "Out Booms," and "Tend the Lifts and Braces."

ATTENTION TO THE ORDER TO FOLLOW.



Call in the closed position and clinch within a second. Impulse the shrill call with the lung force about three times and end sharp.

The length of this call should be not less than five nor more than ten seconds. Sing out the words "D'ye hear there," or "D'ye hear there, Fore and Aft," then wait for all hands to silence and pass the word as given by the officer-of-the-deck. Such as:

Officer-of-the-Deck calls boatswain's mate. Boatswain's Mate answers, "Sir." Officer-of-the-Deck, "Pass the word, 'The mail closes for the United States in ten minutes.'" Boatswain's Mate, "Aye, aye, sir," and then proceeds as above, "D'ye hear there, fore and aft, the mail closes," etc.

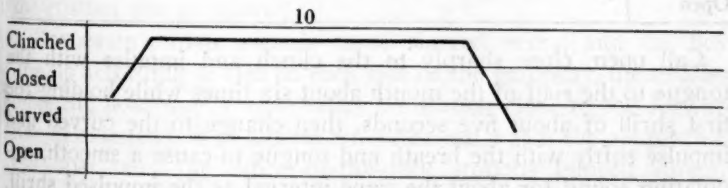
The words fore and aft are omitted when the order passed does not concern the officers as well as the men.

The language used in passing words was couched more in the vernacular of the sailor than in academic English, and the officer who did not regard the sailor's grasp on English usually got poor results from the boatswain's mate, who had his own idea of how the word should be passed, and got muddled in interpreting the officer-of-the-deck.

I might cite the following as an example:

The officer of the morning watch had orders to have the decks dried down by six bells and gave this order: "Boatswain's Mate, scrub down with rapidity." This was a new one on the boatswain's mate, and, after causing the officer-of-the-deck to repeat the order three times, the boatswain's mate became desperate, grabbed a deck bucket, which he forced into the hand of the nearest apprentice, whom he started on his way with a push that sent the youngster reeling towards the fore hatch followed by this shout from the boatswain's mate, "Go to the captain-of-the-hold and ask him for a bucketful of it. I never heard of anything to scrub a deck with but sand and lime, and I don't know anything about these new 'soogy-moodgies' anyway."

HOIST AWAY.

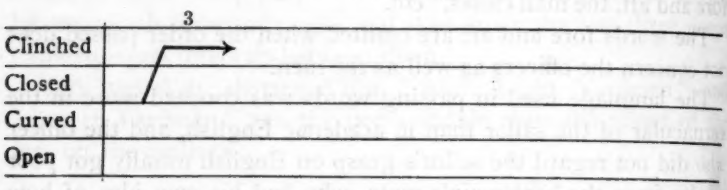


Same as attention, excepting that the shrill is not impulsed and the shrill is softened by changing the position from clinched to

curved, and the lung pressure is lessened so as to finish low and soft, instead of sharp.

The length of this call is about ten seconds for such a signal as the "Men can run or make a long walk away in hoisting," such as in crossing yards, hoisting topsails, hoisting boats, or in the walk away of the cat, or fish falls, and it always is preceded by the signal to "Set Taut."

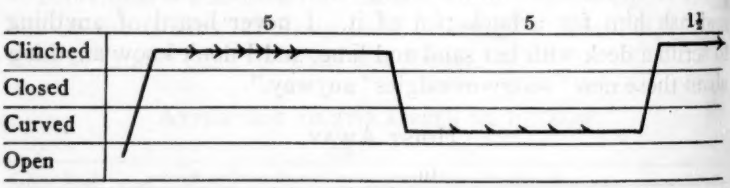
HAUL.



Call in the closed position and change to the clinched, and so timed as to sound about an equal length of time in each position; finish with a sharp shrill. The normal time about 3 seconds.

This signal is used at such times as the men are facing their work at a standstill and in position for a pull together. The low note of the signal is "Stand By," and the shrill note "Pull." This is repeated as often as the signal is blown and the length of the shrill note signifies the strength and amount of rope to be gained in the pull, so that as the signal is shortened it becomes the first note of the "Short Belay."

BELAY.



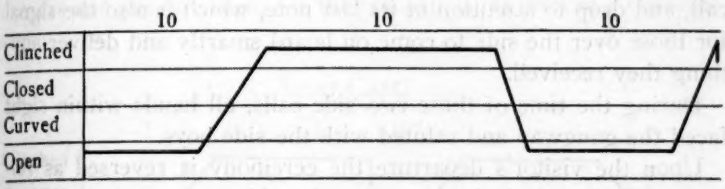
Call open, close sharply to the clinch and impulse with the tongue to the roof of the mouth about six times while holding the first shrill of about five seconds, then change to the curved and impulse softly with the breath and tongue to cause a smooth, undulating sound for about the same interval as the impulsed shrill, then clinch sharply and finish with three shrill slurred peeps in rapid succession.

This is the most difficult signal to blow, and I have never heard it sounded exactly the same by any two men; though the contraction of it, "The Short Belay," is more uniform in sound as it really grows out of the short pull.

The nearer the long belay imitates the song of the canary bird, the more the signal is admired, and the man who has an ambition to excel as the user of a call could have no better teacher than the canary, particularly for the signals of the Long Belay, the Haul and the Veer.

Omitting the staccato notes in the song of the canary, it becomes almost an ideal belay, and the staccato trill of his song is almost an ideal veer or pipe down.

SIDE CALL.



Fill the lungs, commence with the lowest smooth note and rise to the shrill, then fall to the low note again and finish with a low, soft shrill.

The time in rising to the shrill should be about equal to the time of holding the shrill, and the time of falling from the shrill should be about one-third less than that of rising, so that the times of rising, holding and falling to a finish are about equal.

Side boys were selected from the youngest and most natty of the apprentices. They were lined up and drilled in their duties by the boatswain's mate of the starboard gangway, and were eight in number.

Should the officer-of-the-deck order "Tend the side six boys" the custom was as follows:

Boatswain's mate signals three slurred veers, and the boys line up according to size on each side of the gangway, the smallest inboard; boatswain's mate takes his station close to the forward line of side tenders at a point where he can watch the approach of the boat, and the officer-of-the-deck stations himself directly inboard of the gangway and facing outboard.

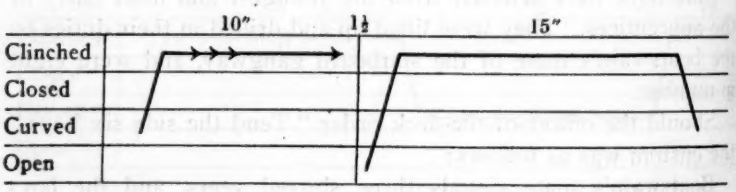
The boatswain's mate starts the "Alongside" in time to finish as the boat touches the gangway, and at the first note of this call the two inboard boys go over the side smartly to tend the short manropes and to give a hand, if necessary, to the visitor when the weather is rough on the lower grating, then they stand at a salute without obstructing the visitor as he commences to climb the side ladder, and they receive any package or papers the visitor may wish to follow him on board.

The boatswain's mate commences his pipe over in time to finish it when the visitor is greeted by the officer-of-the-deck, and at the first note of this signal the boatswain's mate takes his station close to and about one pace forward of the inboard boy in the forward line of side tenders, and all side tenders come to the hand salute and remain in that position during the sound of the call, and drop to attention at its last note, which is also the signal for those over the side to come on board smartly and deliver anything they received.

During the time of these two side calls, all hands within sight faced the gangway and saluted with the side boys.

Upon the visitor's departure the ceremony is reversed as follows: Outboard tenders go over the side as soon as called or motioned to do so. Boatswain's mate commences the first notes of "Over the Side" as the visitor passes him in departing and the first notes of "Away" as the visitor's boat gathers headway and curves away from the gangway in departing, and this signal should be very long-drawn in the finish.

ALL HANDS.



Close to the clinched and impulse softly about three times, holding the shrill for ten seconds, ending sharp, then again close to the clinched softly and hold the second shrill for ten seconds and allow it to fall softly to a finish for three seconds.

This is a General Call to be passed in chorus by the boatswain and all his mates as before described, except for calling the

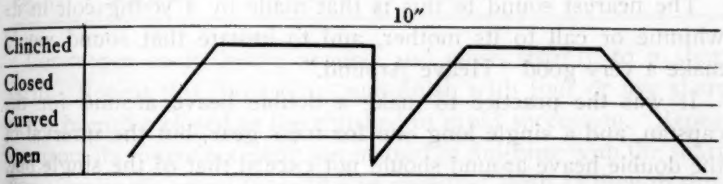
first watch at 8.00 p. m., when it becomes the duty of the chief mate to see and report to the boatswain "All relieved forward"; the mate of the starboard gangway reporting all relieved on the bridge and the gangways, and the mate of the quarter-deck reporting all relieved aft.

The boatswain then reports "All relieved, sir," to the officer-of-the-deck, who replies, "Very good, sir; set the watch."

The boatswain and his mates then blow the long Attention Call, saying in chorus, "All the Watch."

In the call of all other watches, the boatswain's mate of the watch called the watch on the deck the watch was turned in on, and, after singing out the watch to be called, roused them out with a "Rouse out here, rouse out here, all you sleepers," and other remarks fitting the occasion, serving to rouse out the sleepers and prepare them for the conditions on deck in a cheerful mood.

BOAT CALL.



Call in the open, close to the clinched, hold the shrill for five seconds, then open and close again to the clinch and hold the second shrill for another five seconds, then open and allow the signal to end softly, allowing about three seconds for the fall to silence.

All hands should listen to this call, as the boatswain's mate is to sing out in a long-drawn "Away" the boat that is to be manned, and it was the custom to use the word away for the second time in the call of the barge and the gig, such as "Away, the barge (or gig), Away."

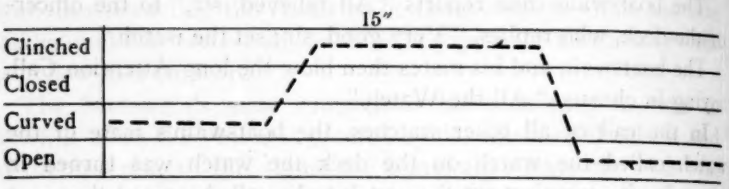
This call was also used in calling a gun division or divisions to quarters, such as "All the gun divisions,—or all the first division,—to quarters."

The boatswain's mate looked for silence as in after the "Word to be Passed" signal, and then pitched his voice in a roaring song,

raising it to its full power on the first word of the call, and lowering it on the last syllable of the last word.

The interval of the song was about equal to the interval of the call.

HEAVE AROUND.

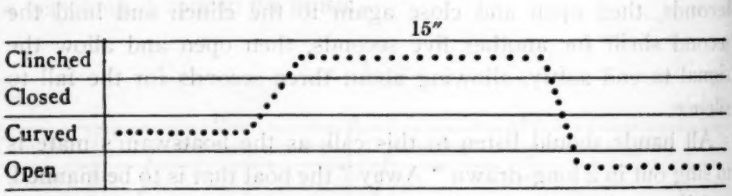


Call in the curved, and blow very softly with an undulating sound by checking the breath with the throat and allow the tongue to slowly undulate, then in the clinched position and increase the rapidity of the undulations from about the same interval as during the rising, then allow the sound to fall back to the soft, low tones of the start.

The nearest sound to this is that made by a young colt in its whinnie or call to its mother, and to imitate that sound would make a very good "Heave Around."

It was the practice to make a double heave around for the capstan, and a single long one for mess gear, but the interval of the double heave around should not exceed that of the single one.

VEER.



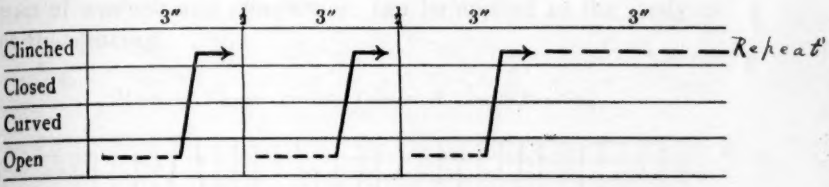
Call in the curved and blow to imitate a whistle rattled by a pea. This rattling sound is produced by ballarding the tip of the tongue against the roof of the mouth and the rapidity of the ballarding is in proportion to the pitch of the sound, rising to the maximum in the shrill rattle.

In port, this signal calls two side boys and at sea it signaled Hold the Reel, or Heave the Log, and signaled Hurrah in cheering ship.

For lowering yards, or walking back a fall or falls, this signal was sounded continuously during the walk back or the lowering from a belay, and the speed of the lowering was in proportion to the undulations of the signal, or the rapidity of its rising or falling in sound caused by changing from curved or open to clinched, and sometimes accentuated by impulsing with the throat, and short peeps of it indicated to lower handsomely for a short distance in the case of fouling while lowering.

At the finish of the lower or come up, the signal was finished with a short, sharp peep as in the finish of " Pipe Down."

PIPE SWEEPERS.



Commence as in heave around and close sharply to a short shrill. Repeat this three times and finish with four or five sharp peeps from the closed to the clinched in rapid succession. Repeat this from its commencement, but instead of finishing with the sharp peeps, make the sound more like an impulsed shrill as though slurring the peeps.

After the blowing of this call it was usual for the boatswain's mate to pass such directions to the sweepers as the occasion called for, such as: " Clean, sweep down fore and aft," " Stow away all cleaning gear, ditty bags and boxes, empty out all spit kits, flemish down all gear."

Clear up the decks for quarters, and perhaps, in sotto voce, such a remark as this, " Not a broom straw in the scuppers, or a marine's head above a dead eye."

COMBINATION CALLS.

PIPE TO (ANY) MEAL.

Signal All Hands, long Heave Around and long Pipe Down.

The combined calls should cover an interval of not less than one minute.

PIPE DOWN.

This call was a combination of the signal "Attention to the Word" and a long veer of about ten seconds, ending in a sharp, short peep, with an interval of one second between the two signals.

This signaled the termination of all evolutions and ceremonies to which all hands had been called, and was blown by the boatswain's mate of the watch. After the sounding of taps the words "Silence fore and aft" followed the Pipe Down on that occasion.

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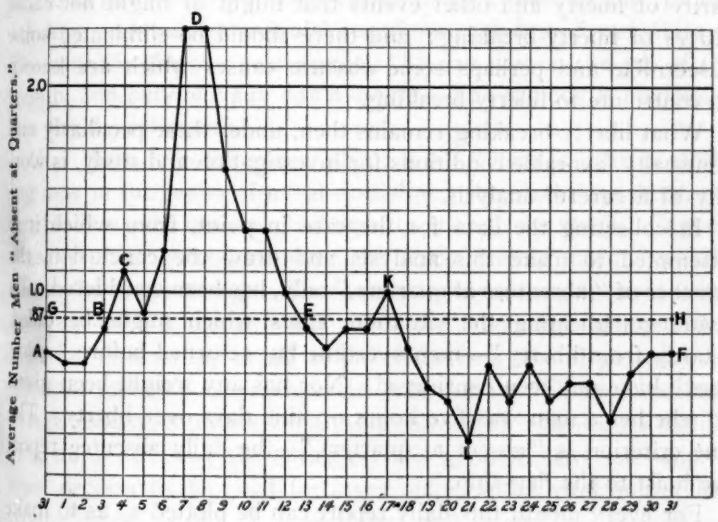
U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A DIRECT CAUSE OF LIBERTY-BREAKING.

By COMMANDER W. W. PHELPS, U. S. Navy.

There is every reason why those principles of "scientific management," under which *results* are examined after successive processes of *analysis* and *elimination*, can be applied to the study of *liberty-breaking*.

Mean of Eleven Monthly Curves of Liberty-Breaking.



Calendar Days.

Liberty-breaking is the result of a number of causes. Some are (a) inherent in mankind. Some are (b) obscure. Some are (c) discernible.

If, by a process of elimination, we can rid ourselves of those causes in class (c) which are the most readily detected, it is not

impossible, by a succeeding process of analysis and study, that eventually some of the more obscure causes, those in category (b), may come to light, and thus afford us further points for administrative attack.

Captain Fullam, in his paper "Absence over Leave in the Fleet," brought clearly to light what had theretofore been the chief cause of liberty-breaking; namely, *toleration*—one of the causes in class (c). And he showed clearly that this cause could be removed by (a) instilling into the men (and officers) an understanding that this offence was serious, *not* trivial; and (b) by backing that up by treatment that showed that he meant what he said.

Given a ship in which it has been the endeavor, by following the precepts and methods formulated by Captain Fullam, to eliminate the chief cause, *toleration;* a ship that has for about a year been operating under rather constant conditions in respect to regularity of liberty and other events that might or might not cause *waves* of liberty-breaking; and there should be eliminated some discernible and perhaps some obscure causes which are known to contribute to liberty-breaking.

What liberty-breaking remains then, under these peculiarly and unusually favorable conditions for investigation and study, is worthy of a careful analysis.

In collecting the data for the case in point, from which it is attempted to make this analysis and draw the conclusion, the number of "absentees at quarters," only, has been considered. To avoid complicating the situation, cases which might be called "tardy from liberty"—men overtime but returned before "quarters" have not been considered. Nor has any weight been given to whether a man was five hours or nine days over liberty. The one criterion is "absent at quarters"—the daily absentee report we hoist to the flag-ship.

For every month this daily report can be plotted so as to make a curve of liberty-breaking for the month. In the case of the ship in question these curves have been averaged into the curve herewith. AF is the ship's mean *curve of liberty-breaking* for the period of eleven months.

The analysis of the diagram discloses:

(a) The line GH is the mean daily average number of men absent from quarters breaking liberty throughout the eleven months; in this case 0.87 of a man per day.

(b) Where the curve falls under this line conditions are improving.

(c) Where the curve rises over this line, there are the unhealthy spots, and there must the cause be sought.

(d) The small hump at C shows the influence of 4th of July, and of its pay day preceding, and of some few pay days which fell on the 4th of the month because the 5th fell on a Sunday.

(e) The small hump at K is unaccounted for, and its cause is obscure—category (b) if not category (a).

(f) The drop of the curve to L on the 21st day shows conditions approaching sanity; and there is no reason why the curve should not have gone on from the 21st day to the 31st day at about L (0.26 of a man per day absent) except that

(g) The rise from L to FA shows the influence of Thanksgiving season and Christmas holidays on liberty-breaking.

(h) *The badly diseased part of the curve is the hump that begins to rise on the 5th day, reaches its maximum on the 7th and 8th days, and remains unhealthy until the 13th day—for eight days.* The cause is obvious (category (c))—pay day on the 5th of the month, and *only one pay day a month.* The remedy is obvious—*two pay days a month.*

Now there is nothing new about this. There is little or nothing new in the realm of naval discipline; the *truths* are there, the trouble is we do not search diligently enough for them. Captain Huse reports (PROCEEDINGS, No. 140) having used "weekly money" with advantage. There are possibly some ships now using two pay days a month—and all to the advantage of their discipline. Otherwise, in all ships, there is a liberal granting of "special money" when the man *asks* for it. There is nothing in Art. 3669 N. R. to *prevent* all ships having two pay days a month. If a thing affecting the entire crew is good for any one ship, it must necessarily be good for *every* ship; and a vital matter like paying money is one of those things that should be *standardized.* If it can be shown that two pay days a month will improve morale, then it is *imperative* that it should be *uniform in all ships,* for whatever will improve morale will reduce liberty-breaking and add to military contentment. It is the absence of uniformity that engenders military discontent. Where an investigation is made, using intelligent and reliable sources that are more or less

constantly in touch with men representing the best elements in all the ships of any one command, it will be found that in the navy to-day there is *no underlying grievance,* no underlying cause for the *military* discontent that exists. It can possibly be said that the c. s. c. men—those to whom the navy is a career, yearn for the day when the graded retirement bill fathered by Rear Admiral Dillingham becomes a law; and this may be said to be a very just yearning, for a man-o'-wars man is often an old man at fifty, when an officer may then be in his prime. And that the Department is possibly not as much concerned about the passage of this bill as it is about the passage of the naval personnel bill dealing with the officers may be to a small extent a grievance, for both measures should be equally urged. But the young and happy-go-lucky first-enlistment man never thinks of retirement laws. He is not sure now whether he will ship over or not. *His* grievance will be found to be trivial, in a sense, though important in its general effect. His grievance (and here it is believed lies the *military discontent*) is because of lack of uniformity among ships, inconsistencies that he sees, differing methods, lack of standards, one way of doing a thing now and a month hence another way of doing the same thing, and both different from the way it was done a month ago. All these he learns either in conversations with men of other ships or else in the frequent transfers he nowadays has to make from ship to ship. It is this that causes a state of unrest, a condition of not knowing what to expect next, and it has the bad effect on morale of deranging that mental attitude which in every man should be unruffled toward the service, no matter in what ship he may be. This is where the demand seems to arise for standardization among all the ships of all those things that affect equally all the men of a ship's company.

From these illustrations and this reasoning, it follows that the principle of two pay days a month should be made *mandatory* by Art. 3669 N. R.

Will some say that two pay days a month will double the liberty-breaking?

It is impossible. It is too unreasonable to admit of argument. On the contrary, wherever and whenever we can mitigate some of the abnormalities of naval life and narrow the gulf between life in the navy and life on shore, we shall improve naval discipline.

Two pay days a month will approach toward the weekly pay day in civil life. For the sake of argument let us go further. Reduced to a daily pay day, it might be said that *all* liberty-breaking except casual tardiness would in time almost disappear; for it has been said several times in the pages of this publication that liberty-breaking is at bottom due to the debauchery made easy by the "feast and famine" method of paying the men. This kind of debauchery requires a month's pay in a lump sum. Spread it out in sensible portions and there cannot be so much debauchery.

What is the natural result of one pay day a month on the *vast majority who never break liberty?*

On those men with families there are at times extraordinary demands that force the men to request special money. No man *likes* to ask for *anything*. It goes against his grain. It is repugnant to democratic human nature. For all these men two pay days a month will meet their needs without their having to ask. Two pay days a month will practically abolish the special-money requisition evil, and thus save in the aggregate an enormous amount of time and paper work.

Of the men without families many "blow in" their money on the first few days after pay day; thereafter they stay on board ship and tend to get stale. The system should be such as to encourage men to get ashore whenever they are on the liberty list; for simply getting away from the restraints of naval routine and the effects of shipboard surroundings for frequent short periods, will give them in the long run a healthier mental attitude toward the service. This can be brought about by distributing their money more evenly through the month.

What might be the objections to two pay days a month?

"Ship's work" can very well spare the time required for the extra money issue. In our five turret ships they can make a monthly money issue within forty-five minutes—before morning quarters. In a ship with a reserve complement they make the issue in seven to ten minutes.

The pay officer's objection will not be valid when he stops to think that there will be actual time and paper work saved with two pay days a month and without endless special money requisitions, as against one pay day a month and time and paper work consumed in numerous special money requisitions.

In any event time and trouble are nothing where the morale of the men is concerned.

Liberty-breaking is diminishing from year to year. It will continue to diminish. Eventually it will cease to be a trouble. But so long as even *one* man is a liberty-breaker, there is justification in *trying* to find out *why*.

To-day the chief cause of liberty-breaking is that there is only one pay day a month, and this can be remedied by the stroke of a pen.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE DETERMINATION OF A FIX FROM TWO LINES OF POSITION.

DR. FULST'S β TABLE, A NEW "PROTRACTOR DIAGRAM" AND T SQUARE. A NEW SOLUTION OF AN OLD PROBLEM.

By LIEUT. COMMANDER RADLER DE AQUINO, B. N.,
Naval Attaché to the Brazilian Embassy.

Although published as long ago as October, 1899, in the *Annalen der Hydrographie und Maritimen Meteorologie,** Dr. Fulst's Table for finding the angle β between the larger intercept and the intercept between the assumed position and the fix (the intersection of two lines of position) is practically unknown to the nautical world.

Although reprinted in Breusing's *Nautische Tafeln*, 1909, and used in the German Merchant Marine to a certain extent, this valuable little table is not officially used in the German Navy, where the fix is determined by a special four-page table using Marcq St. Hilaire's method in its original form, theoretically more exact, but presenting an unsymmetrical and less practical appearance.

Let us suppose, in Fig. 1, that O is the assumed position, $OA(=\Delta h_1)$ and $OB(=\Delta h_2)$ are the intercepts or differences between the two calculated and true altitudes $(\Delta h_1 > \Delta h_2)$, AP and BP the lines of position, P the "fix" and OP the *fix intercept.*

The angle β given in the appended tables calculated by Dr. Fulst is the angle AOP, the inclination of the fix intercept (Besteckversetzung) upon the greater intercept OA. As the latitude and longitude of the O are assumed and Δh_1, Δh_2 and the corresponding azimuths Z_1 and Z_2 are given, we may find very easily by means

* "Zur Berechnung des Schiffsortes aus zwei Gestirnshöhen nach der Höhenmethode" (mit einer Hülfstafel).

of this β Table and the ordinary Plane Traverse Tables the angle β and the length and bearing of the fix intercept in miles and therefore deduce immediately from O the latitude and longitude of the fix P.

If we call δ the angle AOB we notice that it is equal to Z_1+Z_2 (the difference in azimuth between the two bodies) because in the figure Δh_1 and Δh_2 have the same sign, both + or −. If one was + and the other − the angle δ would be equal to the supplement of the azimuth difference.

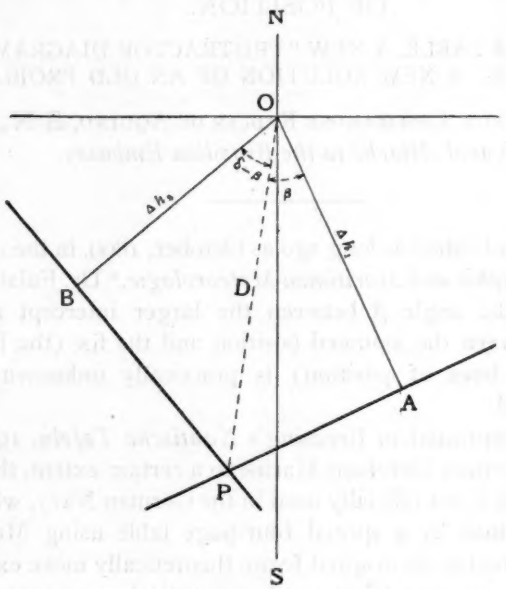


FIG. 1.

However, the angle δ in practice is always more readily found by noting the difference in azimuth or bearing between the two computed points A and B.

Example:

A.....S 25° E.....$\Delta h_1 = +8'.8$
B.....S 50° W.....$\Delta h_2 = +7'.8$

$\delta = 75°$

If the bearings of A and B were expressed in arc from 0° to 360° then, of course, the difference between them would always give us the value of δ.

Once β is known it is easy to find the direction or course of the fix P by means of the known direction or course of the computed point A corresponding to the larger intercept.

The tables giving β were computed by means of the following formula:

$$\tan \beta = \frac{\Delta h_2}{\Delta h_1} \cdot \operatorname{cosec} \delta - \cot \delta,$$

deduced in the following way.

In the triangle AOP we have

$$\Delta h_1 = D \cos \beta, \qquad (1)$$

and in the triangle BOP,

$$\Delta h_2 = D \cos(\delta - \beta),$$

and, therefore,

$$\frac{\Delta h_2}{\Delta h_1} = \frac{\cos(\delta - \beta)}{\cos \beta},$$

or

$$\frac{\Delta h_2}{\Delta h_1} = \frac{\cos \delta \cos \beta + \sin \delta \sin \beta}{\cos \beta},$$

or

$$\frac{\Delta h_2}{\Delta h_1} = \cos \delta + \sin \delta \tan \beta;$$

from which we have

$$\tan \beta = \frac{\frac{\Delta h_2}{\Delta h_1} - \cos \delta}{\sin \delta},$$

or, finally,

$$\tan \beta = \frac{\Delta h_2}{\Delta h_1} \cdot \operatorname{cosec} \delta - \cot \delta. \qquad (2)$$

For the sake of simplicity the arguments of the β Table are δ and $\frac{\Delta h_1}{\Delta h_2}$ instead of δ and $\frac{\Delta h_2}{\Delta h_1}$, as $\Delta h_1 > \Delta h_2$ it is easier to divide Δh_1 by Δh_2 than Δh_2 by Δh_1. For this purpose, however, we have appended here also two pages of our Readyreckoner which saves the trouble of dividing Δh_1 by Δh_2.

These tables are entered at the top with Δh_1 and with Δh_2 inside;

in the left hand outside column we find $\frac{\Delta h_1}{\Delta h_2}$; in the right hand outside column is given $\frac{\Delta h_2}{\Delta h_1}$.

When β is + (plus) the fix intercept lies between the larger and smaller intercepts. When β is − (minus) the fix intercept lies on the outside of the angle comprised between the larger and smaller intercepts.

Besides the β Table, Dr. Fulst published at the same time a two-page table based on the formula (1),

$$\Delta h_1 = D \cos \beta,$$

or

$$D = \Delta h_1 \sec \beta,$$

from which he found the length of the fix intercept.

As this table is already comprised in the Plane Traverse Tables in which we have to enter to finish the problem after the course and distance of P from O are found we have not given his tables for finding D.

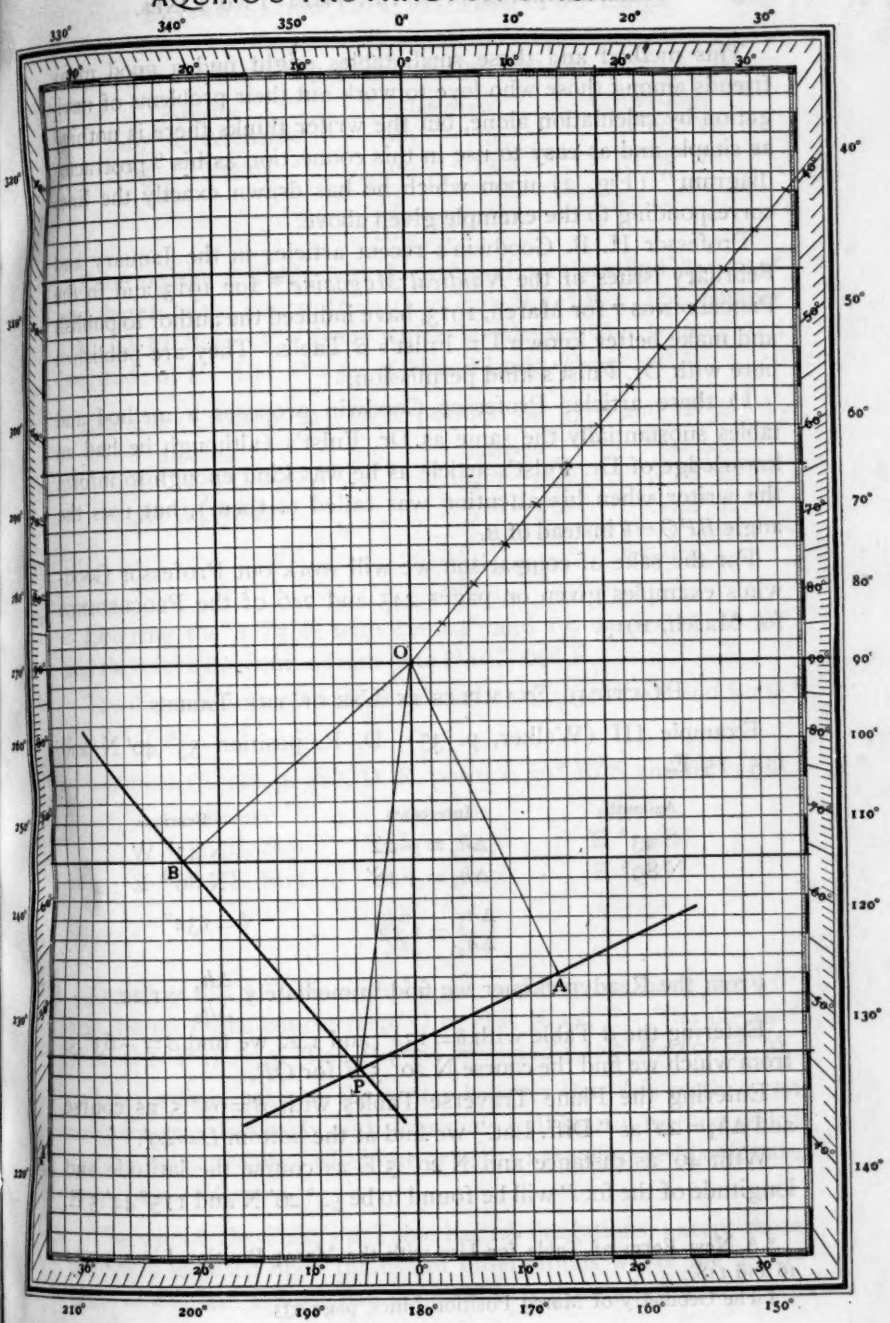
A few examples will show the simplicity and readiness of the use of this process for calculating the fix.

Azimuths	Intercepts	Computed Points	Bearings
S 25° E.....	$\Delta h_1 = +8'.8$	A	S 25° E
S 50° W.....	$\Delta h_2 = +7'.8$	B	S 50° W
	$\frac{\Delta h_1}{\Delta h_2} = 1.13$		$\delta = 75°$

Entering the β Table with $\delta = 75°$ and $\frac{\Delta h_1}{\Delta h_2} = 1.13$ we will find between columns 1.10 and 1.15, $\beta = +33°$. As the direction of A (the computed point corresponding to the greater intercept) is S 25° E we have for the course of P:—S 8° W. Entering the Plane Traverse Tables with $\beta = 33°$ as course and the greater intercept 8′.8 as "Diff. Lat." we find as the distance D or $OP = 10'.5$. Running down the same distance column we find corresponding to course S 8° W: Diff. Lat. 10′.4 S, Dep. 1′.5 W, and the corresponding Diff. Long. 1′.9 W.

If the latitude and longitude of O were Lat. 39° 36′ N and Long. 24° 50′ E we would have for the latitude and longitude of P: Lat. 39° 25′.6 N and Long. 24° 48′.1 E.

AQUINO'S PROTRACTOR DIAGRAM



Published by J. D. Potter, 145, Minories, London, E. C. Issued in blocks of 100 @ 4s. net.

Reduced to ⅔ of original.

This method and these small tables might find a good many friends among those who love to work out their problems of navigation by calculation alone, but the writer thinks there is nothing as simple and as easy to use in this connection as his "protractor diagram" (Fig. 2) upon which he has drawn exactly the lines corresponding to the example given above.

Professor H. B. Goodwin's recent articles in the January and February issues of the *Nautical Magazine* * for 1913 and in the PROCEEDINGS † for March, 1913, have induced the author to publish and make better known Dr. Fulst's β Table. They are published here with Dr. Fulst's kind permission.

In these articles Professor Goodwin proposes a method and tables substantially the same as Dr. Fulst's (although he had no knowledge of Dr. Fulst's article as he was kind enough to inform the writer when his attention was called to them), but uses the angle $BPO=\theta$ instead of β.

For the sake of comparison we will work out Professor Goodwin's examples given on pages 245 and 246 of the PROCEEDINGS for March, 1913.

PRACTICAL EXAMPLES IN USE OF THE TABLES.

Example III (Walker, p. 35), D. R. position 53° 40′ N and 115° 15′ E.

Azimuths	Intercepts	Bearings
S 43° E	$\Delta h_1 = -22'$	N 43° W
N 89° E	$\Delta h_2 = +18'$	N 89° E
	$\frac{\Delta h_1}{\Delta h_2} = 1.22$	$\delta = 132°$

From the Readyreckoner we find immediately $\frac{\Delta h_1}{\Delta h_2} = 1.22$.

Entering the β Table with $\delta = 132°$ and 1.22 we find $\beta = +63°.5$, from which we find the course N 20°.5 E for OP.

Entering the Plane Traverse Tables with $\beta = 63°.5$ as course and $\Delta h_1 = 22'$ as "Diff. Lat." we find at the bottom $D = 49'$.

With 49′ as distance and N 20°.5 E as course the latitude and longitude of the fix P will be found to be 54° 26′ N and 115° 44′.5 E.

* A New Form of Table for Use with the Marcq Position Lines, pages 16 and 118.

† The Geometry of Marcq Position Lines, page 233.

Example V (Walker, p. 50), D. R. position 54° N and 5° W.

Azimuths	Intercepts	Bearings
S 67° E, Arcturus	$\Delta h_1 = -15'.1$	N 67° W
S 25° E, Venus	$\Delta h_2 = -13'.5$	N 25° W
	$\frac{\Delta h_1}{\Delta h_2} = 1.11$	$\delta = 42°$

Entering the β Table with $\delta = 42°$ and 1.11 we find $\beta = +13°$ and therefore the course from O to P is N 54° W. The distance from O to P is 15'.5 from which we deduce the latitude and longitude of P: Lat. $P = 54°\ 9'$ N and Long. $P = 5°\ 21'$ W.

Example (Cross, p. 22), D. R. position 34° 37′ S and 12° 21′ W.

Azimuths	Intercepts	Bearings
S 28° W, α Centauri	$\Delta h_1 = -9'.5$	N 28° E
N 48° W, Altair	$\Delta h_2 = -5'.0$	S 48° E
	$\frac{\Delta h_1}{\Delta h_2} = 1.9$	$\delta = 104°$

Entering the β Table with $\delta = 104°$ and 1.9 we find $\beta = +38°$ and therefore the course from O to P is N 66° E.

The distance from O to P is 12'.1. Lat. $P = 34°\ 42'$ S and Long. $P = 12°\ 7'$ W.

Example (Cross, p. 28), D. R. position 39° 10′ S and 60° 45′ E.

Azimuths	Intercepts	Bearings
N 5° E, Sun	$\Delta h_1 = +45'$	N 5° E
N 61° E, Sun	$\Delta h_2 = +29'$	N 61° E
	$\frac{\Delta h_1}{\Delta h_2} = 1.55$	$\delta = 56°$

Entering the β Table with $\delta = 56°$ and 1.55 we have $\beta = +6°$ and therefore the course from O to P is N 11° E. The distance from O to P is 45'.3. Lat. $P = 38°\ 26'$ S and Long. $P = 60°\ 56'$ W.

After a little practice the writer believes that this method can compare very favorably with Johnson's well-known method which fails or cannot be used when one or both of the observed bodies are near the meridian.

The use of Dr. Fulst's β Table has no limitations, except those naturally imposed upon the use of observations where the difference in azimuth is less than 20°. This is generally the accepted

limit and for this reason δ is only given from 20° to 160°. This limitation is common to all methods.

A NEW SOLUTION OF AN OLD PROBLEM.

The advantages of the use of Dr. Fulst's β Table are better shown in working out the classical *noon* position (still officially required in the U. S. Navy by Arts. 1602 and 2609(b), Naval Instructions, 1913), deduced by combining the morning (or afternoon) sight of the sun with the meridian sight of the same body. Sights of the moon, planets and stars can also be worked out by this method in order to obtain the ship's position at the time of their meridian sights.

*Example.**—On February 21, 1910, about 8 o'clock a. m. in Lat. by D. R. 36° 56′ N and Long. by D. R. 8° 9′ W, the observed altitude of the sun's lower limb bearing southward and eastward was 20° 59′.2 at $21^h\ 6^m\ 11^s$ of chronometer $6^m\ 59^s$ slow of G. M. T. Height of eye 36 ft. The run from 8 o'clock to noon was 5′.5 N in latitude and 40′.4 in longitude. The observed meridian altitude of the sun was 42° 35′.6. Back towards the elevated pole.

What was the ship's position at noon?

C. $= 21^h\ 6^m\ 11^s$
C. C. $= +6^m\ 59^s$
G. M. T. $= 21^h\ 13^m\ 10^s$
Eq. of T. $= -13^m\ 46^s$
$a = \mathbf{52°\ 0'}$ G. A. T. $= 20^h\ 59^m\ 24^s$ or $t_G = 314°\ 51'$
$b = \mathbf{17°}$ ..... $d' = \mathbf{10°\ 22'}$ ..... $t_A = \mathbf{53°\ 14'}$ E ..... $a = \mathbf{76°.5}$
$L_A = 37°$ N $d = 10°\ 27'$ S $G_A = 8°\ 5'$ W
$d - d' = +5'$
$C = 54°$ ..... $h' = \mathbf{21°\ 13'}$ ..... $Z_A' = $ S $\mathbf{57°\ 42'}$ E ..... $\beta = \mathbf{60°.2}$
$\Delta h = -3'.7$ $M = 136°.7$
$h_A = 21°\ 9'.3$
$h = 21\ 7$
$h - h_A = -2'.3$

NOTE.—Numbers taken out of the tables by inspection are blackfaced in order to distinguish them from data given or found.

* This example is worked out by means of my The "Newest" Navigation Altitude and Azimuth Tables, second edition, enlarged and improved, Lon-

$a = 52° 0'$

cot a = 0.781 cosec a = 1.269

b / B	Dec. / Alt.	60′ / Δ	H.A. / Az.	Δ / 60′	a / β	c / C
°	° ′		° ′		° ′	°
0	0 0	1.62	52 0	0.00	90 0	90
1	37	1.62	+ 0	.02	89–13	89
2	1 14	1.62	1	.02	88+25	88
3	-51	1.62	+ 2	.03	87 38	87
4	2-28	1.62	4	.03	86–51	86
5	3- 5	1.62	+ 6	0.05	+ 3	85
6	-42	1.67	+ 9	.05	85 16	84
7	4+18	1.62	*12	.07	84+28	83
8	55	1.62	+16	.08	83–41	82
9	5-32	1.67	−21	.08	82 53	81
10	6+ 8	1.62	+26	0.08	+ 5	80
11	-45	1.67	31	.10	81*17	79
12	7+21	1.62	−37	.10	80*29	78
13	-58	1.67	+43	.12	79+41	77
14	8 34	1.67	50	.13	78 53	76
15	9 10	1.67	−58	0.13	− 5	75
16	+46	1.67	53– 6	.13	77 16	74
17	10+22	1.67	14	.15	76+27	73
18	58	1.67	23	.17	75+38	72
19	11–34	1.71	− 33	.17	74+49	71
20	12+ 9	1.67	43	0.18	− 0	70
21	-45	1.71	−54	.18	73+10	69
22	13 20	1.71	54– 5	.20	72+20	68
23	+55	1.71	−17	.20	71+30	67
24	14 30	1.71	29	.22	70 40	66
25	15 5	1.71	42	0.22	69+49	65
26	-40	1.76	+55	.23	68*58	64
27	16–14	1.76	55* 9	.25	+ 7	63
28	48	1.76	24	.25	67 16	62
29	17 22	1.76	+39	.27	66+24	61
30	-56	1.82	55	0.27	65+32	60
31	18+29	1.82	56*11	.28	64–40	59
32	19* 2	1.82	+28	.30	63 47	58
33	*35	1.82	46	.30	62 54	57
34	20+ 8	1.82	57 4	.32	− 1	56
35	-41	1.88	23	0.32	61– 7	55
36	21 13	1.88	+42	.33	60–13	54
37	-45	1.88	58+ 2	.35	59 18	53
38	22–17	1.94	23	.35	58 23	52
39	-48	1.94	44	.37	57+27	51
40	23–19	1.94	59 6	0.37	56*31	50
41	-50	2.00	*28	.38	55+35	49
42	24–20	2.00	*51	.40	54*38	48
43	-50	2.07	60*15	.42	53+41	47
44	25+19	2.07	−40	.42	52–44	46
45	+48		61 5		51–46	45
	a	60′ / Δ	a	Δ / 60′	b	Declination
	142° 0′		Hour		218° 0′	
	38° 0′		Angle		322° 0′	

$a = 36° 30'$

cot a = 1.351 cosec a = 1.681

b / B	Dec. / Alt.	60′ / Δ	H.A. / Az.	Δ / 60′	a / β	c / C
°	° ′		° ′		° ′	°
45	34–39	1.46	46 18	0.50	59+15	45
46	35–20	1.46	*48	.53	58 22	44
47	36– 1	1.50	47 20	.55	57 28	43
48	41	1.50	−53	.55	56 33	42
49	37 21	1.50	48+26	.58	55 37	41
50	38– 1	1.54	49+ 1	0.60	54 40	40
51	-40	1.58	+37	.62	53 42	39
52	39+18	1.58	50+14	.63	52 43	38
53	+56	1.58	*52	.67	51–43	37
54	40 34	1.62	51+32	.68	50–42	36
55	41 11	1.67	52+13	0.70	49 39	35
56	*47	1.67	+55	.73	48*35	34
57	42+23	1.71	53–39	.75	47–31	33
58	*58	1.71	54–24	.77	46–25	32
59	43+33	1.76	55–10	.78	45+17	31
60	44+ 7	1.82	57	0.82	44– 9	30
61	+40	1.82	56 46	.83	42–59	29
62	45 13	1.88	57+36	.87	41–48	28
63	−45	1.94	58 28	.88	40 35	27
64	46–16	2.00	59+21	.92	39 21	26
65	46	2.07	60 16	0.93	38– 6	25
66	47+15	2.14	61+12	.97	36 49	24
67	*43	2.14	62 10	.98	35–31	23
68	48+11	2.22	63 9	1.02	34+11	22
69	−38	2.40	64–10	1.03	32 50	21
70	49* 3	2.40	65–12	1.05	31–28	20
71	+28	2.50	66 15	1.08	30 4	19
72	−52	2.73	67 20	1.10	28–39	18
73	50+14	2.73	68*26	1.13	27+12	17
74	36	3.00	69 34	1.15	25+44	16
75	+56	3.16	70+43	1.18	24 15	15
76	51*15	3.33	71–54	1.18	22–45	14
77	*33	3.53	73* 5	1.22	21–13	13
78	+50	3.75	74+18	1.25	19–40	12
79	52 6	4.29	75–33	1.25	18– 6	11
80	+20	4.62	76–48	1.27	16–31	10
81	+33	5.00	78– 4	1.28	14–55	9
82	+45	5.45	79 21	1.30	13–18	8
83	−56	6.67	80 39	1.32	11–40	7
84	53– 5	7.50	81–58	1.32	10+ 1	6
85	−13	10.0	83 17	1.33	8 22	5
86	−19	12.0	84–37	1.33	6+42	4
87	−24	20.0	85+57	1.35	5 2	3
88	+27	30.0	87 18	1.35	3–22	2
89	+29	60.0	88 39	1.35	1 41	1
90	30		90 0		0 0	0
	a	60′ / Δ	a	Δ / 60′	b	Declination
	126° 30′		Hour		233° 30′	
	53° 30′		Angle		306° 30′	

Applying the run to the assumed latitude and longitude found, we have

$L_A = 37° \ 0'$ N	$G_A = 8° \ 5'$ W
$l = \ 5'.5$ N	$g = \ 40'.4$ W
L_A at noon $= 37° \ 5'.5$ N	G_A at noon $= 8° \ 45'.4$ W

If we consider the intercept $-2'.3$ from this position we will

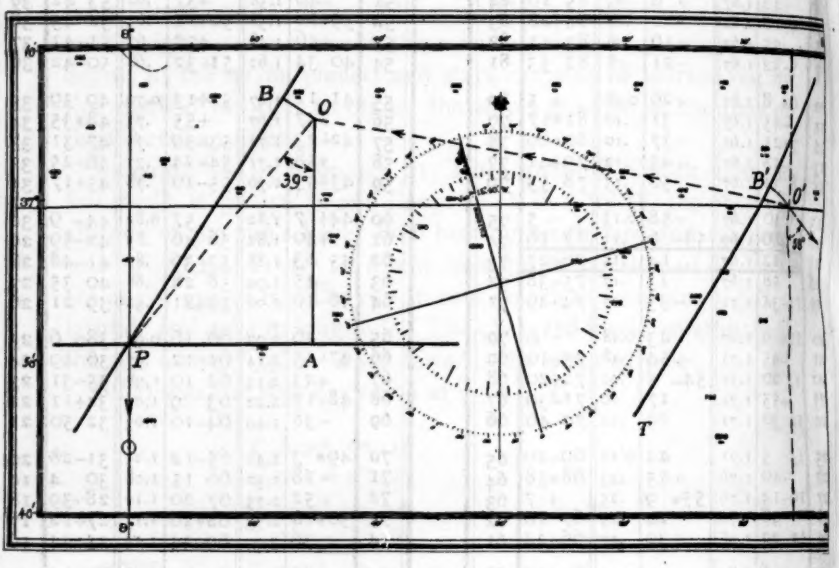


FIG. 3.

have automatically transported the line of position at 8h a. m. to noon, as is clearly shown on the small chart above (Fig. 3).

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don, 1912. Published by J. D. Potter, 145 Minories, London, E. Price, 10s. 6d. net. A specimen of columns $a = 36° \ 30'$ and $a = 52° \ 0'$ of my proposed third edition shows a few improvements and also shows the detailed working of the example given on page 1038. The signs + and — between the arcs enable us to obtain each one always with an approximation of $0'.15$ (*fifteen hundredths of a minute of arc or* 9″). These signs have been introduced to satisfy those who want a still greater approximation than can be obtained by means of the tables with arcs to the nearest minute of arc. The sign + means *add* $0'.3$ (18″) *to arc* and — means *subtract* $0'.3$ (18″) *from arc*. Arcs ending in $0'.5$ (30″) are marked with an asterisk (*), indicating that $0'.5$ should be added to them. With this simple artifice, h', the tabular altitude is always obtained with an approximation of $0'.15$ and h_A, the assumed altitude, with an approximation of $0'.3$.

The Latitude at Noon

$h_m \odot = 42° \ 35'.6$
Corr.$= \quad + 9'.2$
$h \odot = 42° \ 44'.8$
$d \odot = 10° \ 24'.1$
$h + d = 53° \ 8'.9$
True latitude at noon $= 36° \ 51'.1$ N

L_A at noon $= 37° \ 5'.5$ N
L at noon $= 36° \ 51'.1$ N
True latitude is 14'.4 to the south.

Now this difference in latitude may be considered as an intercept corresponding to the sun on the meridian where the azimuth is 0°. Therefore, we have,

Azimuths	Intercepts	Bearings
South	$\Delta h_1 = +14'.4$	South
S 58° E	$\Delta h_2 = - \ 2'.3$	N 58° W
	$\frac{\Delta h_1}{\Delta h_2} = 6$	$\delta = 122°$

Entering the β Table with $\delta = 122°$ and 6 we find $\beta = +39°$ and therefore the course from O to P (see Fig. 3) will be S 39° W and the distance from O to P is 18'.5.

However, in this particular case, it is not necessary to find the course and distance from O to P. *It is sufficient to find the difference of longitude between the assumed position at noon O (or A) and the fix P.*

When we enter the Plane Traverse Tables to find the distance 18'.5 corresponding to $\beta = 39°$ and the larger intercept 14'.4 as "Diff. Lat.," in the column "Dep.," alongside of 14'.4, we find the departure 11.6, which corresponds to the desired difference of longitude 14'.6. If we add this to the assumed longitude of O we will have

G_A at noon $= 8° \ 45'.4$ W
Diff. Long.$= \quad 14'.6$ W
True longitude at noon $= 9° \ 0'.0$ W

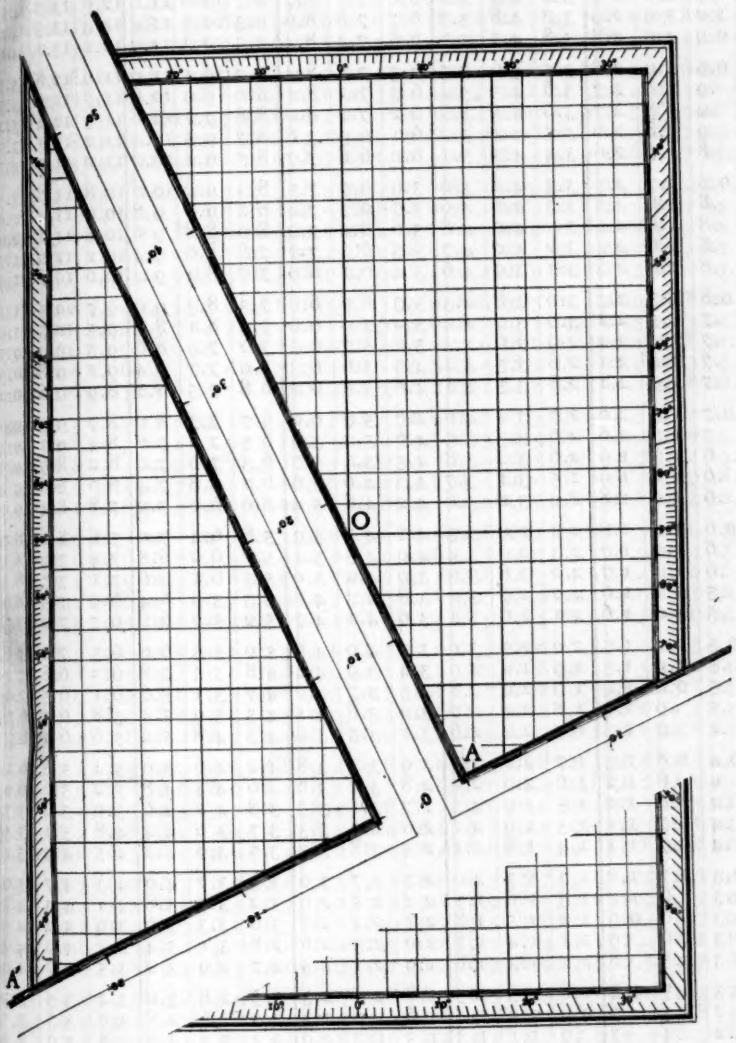
Dr. Fulst's β Table replaces in this case the well-known "Longitude Factor" Tables which are not as convenient as the combined use of the β Table with the Plane Traverse Tables.

FONTOURA'S GRADUATED T SQUARE.

Commander T. A. Newton, of the Portuguese Navy, has just brought to my attention a new graduated T square, invented by Captain Fontoura da Costa, Head of the Department of Navigation of the Portuguese Naval Academy, Lisbon.

I have drawn upon my "protractor diagram" a sketch of it and its use is easily understood, not only for facilitating the plotting of lines of position by Marcq St. Hilaire's method, but also for solving a number of problems usually solved by means of the Plane Traverse Tables. The divisions on the edges are the same as those on the diagram. By means of the diagram and T square, any plane triangle can be immediately formed and solved. The T square on the diagram corresponds to a line of position AA' from a body whose azimuth is S 25° E and an intercept $OA = +17'.6$. The line of position AA' can be immediately drawn after the T square is properly adjusted. It is not necessary to draw the intercept.

FONTOURA'S GRADUATED T SQUARE.



$\frac{\Delta h_1}{\Delta h_2}$	Larger intercept Δh_1															$\frac{\Delta h_2}{\Delta h_1}$
	1′	2′	3′	4′	5′	6′	7′	8′	9′	10′	11′	12′	13′	14′	15′	
1.00	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	1.00
1.02	1.0	2.0	3.0	4.0	5.0	5.9	6.9	7.9	8.9	9.8	10.8	11.8	12.8	13.8	14.7	0.98
1.03	1.0	2.0	2.9	3.9	4.9	5.8	6.8	7.7	8.7	9.7	10.6	11.6	12.6	13.5	14.5	.97
1.05	1.0	1.9	2.9	3.8	4.8	5.7	6.7	7.6	8.6	9.5	10.5	11.4	12.3	13.3	14.2	.95
1.07	0.9	1.9	2.8	3.8	4.7	5.6	6.6	7.4	8.4	9.3	10.3	11.2	12.1	13.1	14.0	.93
1.09	0.9	1.9	2.8	3.7	4.6	5.5	6.5	7.3	8.3	9.2	10.1	11.0	11.9	12.8	13.7	0.92
1.11	.9	1.8	2.7	3.6	4.5	5.4	6.3	7.2	8.1	9.0	9.9	10.8	11.7	12.6	13.5	.90
1.13	.9	1.8	2.7	3.6	4.5	5.3	6.2	7.1	8.0	8.8	9.7	10.6	11.5	12.4	13.2	.88
1.15	.9	1.8	2.6	3.5	4.4	5.2	6.1	6.9	7.8	8.7	9.5	10.4	11.2	12.1	13.0	.87
1.18	.8	1.7	2.6	3.4	4.3	5.1	6.0	6.8	7.7	8.5	9.4	10.2	11.0	11.9	12.7	.85
1.20	0.8	1.7	2.5	3.4	4.2	5.0	5.9	6.7	7.5	8.3	9.2	10.0	10.8	11.7	12.5	0.83
1.22	.8	1.6	2.5	3.3	4.1	4.9	5.7	6.5	7.4	8.2	9.0	9.8	10.6	11.4	12.2	.82
1.25	.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8.0	8.8	9.6	10.4	11.2	12.0	.80
1.28	.8	1.6	2.4	3.2	4.0	4.7	5.5	6.3	7.1	7.8	8.6	9.4	10.2	11.0	11.7	.78
1.30	.8	1.6	2.3	3.1	3.9	4.6	5.4	6.1	6.9	7.7	8.4	9.2	10.0	10.7	11.5	.77
1.33	0.8	1.5	2.3	3.0	3.8	4.5	5.3	6.0	6.8	7.5	8.3	9.0	9.7	10.5	11.2	0.75
1.36	.7	1.5	2.2	3.0	3.7	4.4	5.2	5.9	6.6	7.3	8.1	8.8	9.5	10.3	11.0	.73
1.40	.7	1.4	2.2	2.9	3.6	4.3	5.0	5.7	6.5	7.2	7.9	8.6	9.3	10.0	10.7	.72
1.43	.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	9.1	9.8	10.5	.70
1.46	.7	1.4	2.1	2.8	3.5	4.1	4.8	5.5	6.2	6.8	7.5	8.2	8.9	9.6	10.2	.68
1.50	0.7	1.3	2.0	2.7	3.4	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.3	10.0	0.67
1.54	.7	1.3	2.0	2.6	3.3	3.9	4.6	5.2	5.9	6.5	7.2	7.8	8.4	9.1	9.7	.65
1.58	.6	1.3	1.9	2.6	3.2	3.8	4.5	5.1	5.7	6.3	7.0	7.6	8.2	8.9	9.5	.63
1.62	.6	1.2	1.9	2.5	3.1	3.7	4.3	4.9	5.6	6.2	6.8	7.4	8.0	8.6	9.2	.62
1.67	.6	1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	6.6	7.2	7.8	8.4	9.0	.60
1.71	0.6	1.2	1.8	2.4	2.9	3.5	4.1	4.7	5.3	5.8	6.4	7.0	7.6	8.2	8.7	0.58
1.76	.6	1.1	1.7	2.3	2.9	3.4	4.0	4.5	5.1	5.7	6.2	6.8	7.4	7.9	8.5	.57
1.82	.6	1.1	1.7	2.2	2.8	3.3	3.9	4.4	5.0	5.5	6.1	6.6	7.1	7.7	8.2	.55
1.88	.5	1.1	1.6	2.2	2.7	3.2	3.8	4.3	4.8	5.3	5.9	6.4	6.9	7.5	8.0	.53
1.94	.5	1.0	1.6	2.1	2.6	3.1	3.6	4.1	4.7	5.2	5.7	6.2	6.7	7.2	7.7	.52
2.00	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	0.50
2.07	.5	1.0	1.5	1.9	2.4	2.9	3.4	3.9	4.4	4.8	5.3	5.8	6.3	6.8	7.2	.48
2.14	.5	0.9	1.4	1.9	2.4	2.8	3.3	3.7	4.2	4.7	5.1	5.6	6.1	6.5	7.0	.47
2.22	.5	.9	1.4	1.8	2.3	2.7	3.2	3.6	4.1	4.5	5.0	5.4	5.8	6.3	6.7	.45
2.31	.4	.9	1.3	1.7	2.2	2.6	3.1	3.5	3.9	4.3	4.8	5.2	5.6	6.1	6.5	.43
2.40	0.4	0.8	1.3	1.7	2.1	2.5	2.9	3.3	3.8	4.2	4.6	5.0	5.4	5.8	6.2	0.42
2.50	.4	.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.0	.40
2.61	.4	.8	1.2	1.5	1.9	2.3	2.7	3.1	3.5	3.8	4.2	4.6	5.0	5.4	5.7	.38
2.73	.4	.7	1.1	1.5	1.9	2.2	2.6	2.9	3.3	3.7	4.0	4.4	4.8	5.1	5.5	.37
2.86	.4	.7	1.1	1.4	1.8	2.1	2.5	2.8	3.2	3.5	3.9	4.2	4.5	4.9	5.2	.35
3.00	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	3.7	4.0	4.3	4.7	5.0	0.33
3.16	.3	.6	1.0	1.3	1.6	1.9	2.2	2.5	2.9	3.2	3.5	3.8	4.1	4.4	4.7	.32
3.33	.3	.6	0.9	1.2	1.5	1.8	2.1	2.4	2.7	3.0	3.3	3.6	3.9	4.2	4.5	.30
3.53	.3	.6	.9	1.1	1.4	1.7	2.0	2.3	2.6	2.8	3.1	3.4	3.7	4.0	4.2	.28
3.75	.3	.5	.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4.0	.27
4.00	0.3	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	2.8	3.0	3.2	3.5	3.7	0.25
4.29	.2	.5	.7	0.9	1.2	1.4	1.6	1.9	2.1	2.3	2.6	2.8	3.0	3.3	3.5	.23
4.62	.2	.4	.7	.9	1.1	1.3	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.2	.22
5.00	.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	.20
5.45	.2	.4	.6	.7	0.9	1.1	1.3	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.7	.18
6.00	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5	0.17
6.67	.2	.3	.5	.6	.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	.15
7.50	.1	.3	.4	.5	.7	.8	0.9	1.1	1.2	1.3	1.5	1.6	1.7	1.9	2.0	.13
8.57	.1	.2	.4	.5	.6	.7	.8	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.7	.12
10.0	.1	.2	.3	.4	.5	.6	.7	.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	.10
12.0	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2	0.08
15.0	.1	.1	.2	.3	.3	.4	.5	.5	.6	.7	.7	0.8	0.9	0.9	1.0	.07
20.0	.1	.1	.2	.2	.3	.3	.4	.4	.5	.5	.6	.6	.6	.7	0.7	.05
30.0	.0	.1	.1	.1	.2	.2	.2	.3	.3	.3	.4	.4	.4	.5	.5	.03
60.0	.0	.0	.1	.1	.1	.1	.1	.1	.2	.2	.2	.2	.2	.2	.2	.02

$\frac{\Delta h_1}{\Delta h_2}$	Larger intercept Δh_1															$\frac{\Delta h_1}{\Delta h_2}$
	16′	17′	18′	19′	20′	21′	22′	23′	24′	25′	26′	27′	28′	29′	30′	
1.00	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	1.00
1.02	15.7	16.7	17.7	18.7	19.7	20.7	21.6	22.6	23.6	24.6	25.6	26.6	27.5	28.5	29.5	0.98
1.03	15.5	16.5	17.4	18.4	19.3	20.3	21.3	22.2	23.2	24.2	25.1	26.1	27.1	28.0	29.0	.97
1.05	15.2	16.2	17.1	18.1	19.0	20.0	20.9	21.9	22.8	23.8	24.7	25.7	26.6	27.6	28.5	.95
1.07	14.9	15.9	16.8	17.7	18.7	19.6	20.5	21.5	22.4	23.3	24.3	25.2	26.1	27.1	28.0	.93
1.09	14.7	15.6	16.5	17.4	18.3	19.3	20.2	21.1	22.0	22.9	23.8	24.8	25.7	26.6	27.5	0.92
1.11	14.4	15.3	16.2	17.1	18.0	18.9	19.8	20.7	21.6	22.5	23.4	24.3	25.2	26.1	27.0	.90
1.13	14.1	15.0	15.9	16.8	17.7	18.6	19.4	20.3	21.2	22.1	23.0	23.9	24.7	25.6	26.5	.88
1.15	13.9	14.8	15.6	16.5	17.3	18.2	19.1	19.9	20.8	21.7	22.5	23.4	24.3	25.1	26.0	.87
1.18	13.6	14.5	15.3	16.2	17.0	17.9	18.7	19.6	20.4	21.3	22.1	23.0	23.8	24.7	25.5	.85
1.20	13.3	14.2	15.0	15.8	16.7	17.5	18.3	19.2	20.0	20.8	21.7	22.5	23.3	24.2	25.0	0.83
1.22	13.1	13.9	14.7	15.5	16.3	17.2	18.0	18.8	19.6	20.4	21.2	22.1	22.9	23.7	24.5	.82
1.25	12.8	13.6	14.4	15.2	16.0	16.8	17.6	18.4	19.2	20.0	20.8	21.6	22.4	23.2	24.0	.80
1.28	12.5	13.3	14.1	14.9	15.7	16.5	17.2	18.0	18.8	19.6	20.4	21.2	21.9	22.7	23.5	.78
1.30	12.3	13.0	13.8	14.6	15.3	16.1	16.9	17.6	18.4	19.2	19.9	20.7	21.5	22.2	23.0	.77
1.33	12.0	12.8	13.5	14.3	15.0	15.8	16.5	17.3	18.0	18.8	19.5	20.3	21.0	21.8	22.5	0.75
1.36	11.7	12.5	13.2	13.9	14.7	15.4	16.1	16.9	17.6	18.3	19.1	19.8	20.5	21.3	22.0	.73
1.40	11.5	12.2	12.9	13.6	14.3	15.1	15.8	16.5	17.2	17.9	18.6	19.4	20.1	20.8	21.5	.72
1.43	11.2	11.9	12.6	13.3	14.0	14.7	15.4	16.1	16.8	17.5	18.2	18.9	19.6	20.3	21.0	.70
1.46	10.9	11.6	12.3	13.0	13.7	14.4	15.0	15.7	16.4	17.1	17.8	18.5	19.1	19.8	20.5	.68
1.50	10.7	11.3	12.0	12.7	13.3	14.0	14.7	15.3	16.0	16.7	17.3	18.0	18.7	19.3	20.0	0.67
1.54	10.4	11.1	11.7	12.4	13.0	13.7	14.3	15.0	15.6	16.3	16.9	17.6	18.2	18.9	19.5	.65
1.58	10.1	10.8	11.4	12.0	12.7	13.3	13.9	14.6	15.2	15.8	16.5	17.1	17.7	18.4	19.0	.63
1.62	9.9	10.5	11.1	11.7	12.3	13.0	13.6	14.2	14.8	15.4	16.0	16.7	17.3	17.9	18.5	.62
1.67	9.6	10.2	10.8	11.4	12.0	12.6	13.2	13.8	14.4	15.0	15.6	16.2	16.8	17.4	18.0	.60
1.71	9.3	9.9	10.5	11.1	11.7	12.3	12.8	13.4	14.0	14.6	15.2	15.8	16.3	16.9	17.5	0.58
1.76	9.1	9.6	10.2	10.8	11.3	11.9	12.5	13.0	13.6	14.2	14.7	15.3	15.9	16.4	17.0	.57
1.82	8.8	9.4	9.9	10.5	11.0	11.6	12.1	12.7	13.2	13.8	14.3	14.9	15.4	16.0	16.5	.55
1.88	8.5	9.1	9.6	10.1	10.7	11.2	11.7	12.3	12.8	13.3	13.9	14.4	14.9	15.5	16.0	.53
1.94	8.3	8.8	9.3	9.8	10.3	10.9	11.4	11.9	12.4	12.9	13.4	14.0	14.5	15.0	15.5	.52
2.00	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	0.50
2.07	7.7	8.2	8.7	9.2	9.7	10.2	10.6	11.1	11.6	12.1	12.6	13.1	13.5	14.0	14.5	.48
2.14	7.5	7.9	8.4	8.9	9.3	9.8	10.3	10.7	11.2	11.7	12.1	12.6	13.1	13.5	14.0	.47
2.22	7.2	7.7	8.1	8.6	9.0	9.5	9.9	10.4	10.8	11.3	11.7	12.2	12.6	13.1	13.5	.45
2.31	6.9	7.4	7.8	8.2	8.7	9.1	9.5	10.0	10.4	10.8	11.3	11.7	12.1	12.6	13.0	.43
2.40	6.7	7.1	7.5	7.9	8.3	8.8	9.2	9.6	10.0	10.4	10.8	11.3	11.7	12.1	12.5	0.42
2.50	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.2	9.6	10.0	10.4	10.8	11.2	11.6	12.0	.40
2.61	6.1	6.5	6.9	7.3	7.7	8.1	8.4	8.8	9.2	9.6	10.0	10.4	10.7	11.1	11.5	.38
2.73	5.9	6.2	6.6	7.0	7.3	7.7	8.1	8.4	8.8	9.2	9.5	9.9	10.3	10.6	11.0	.37
2.86	5.6	6.0	6.3	6.7	7.0	7.4	7.7	8.1	8.4	8.8	9.1	9.5	9.8	10.2	10.5	.35
3.00	5.3	5.7	6.0	6.3	6.7	7.0	7.3	7.7	8.0	8.3	8.7	9.0	9.3	9.7	10.0	0.33
3.16	5.1	5.4	5.7	6.0	6.3	6.7	7.0	7.3	7.6	7.9	8.2	8.6	8.9	9.2	9.5	.32
3.33	4.8	5.1	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.7	9.0	.30
3.53	4.5	4.8	5.1	5.4	5.7	6.0	6.2	6.5	6.8	7.1	7.4	7.7	7.9	8.2	8.5	.28
3.75	4.3	4.6	4.8	5.1	5.3	5.6	5.9	6.1	6.4	6.7	6.9	7.2	7.5	7.7	8.0	.27
4.00	4.0	4.3	4.5	4.8	5.0	5.3	5.5	5.8	6.0	6.3	6.5	6.8	7.0	7.3	7.5	0.25
4.29	3.7	4.0	4.2	4.4	4.7	4.9	5.1	5.4	5.6	5.8	6.1	6.3	6.5	6.8	7.0	.23
4.62	3.5	3.7	3.9	4.1	4.3	4.6	4.8	5.0	5.2	5.4	5.6	5.9	6.1	6.3	6.5	.22
5.00	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	.20
5.45	2.9	3.1	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.6	4.8	5.0	5.1	5.3	5.5	.18
6.00	2.7	2.8	3.0	3.2	3.3	3.5	3.7	3.8	4.0	4.2	4.3	4.5	4.7	4.8	5.0	0.17
6.67	2.4	2.6	2.7	2.9	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	4.5	.15
7.50	2.1	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.7	3.9	4.0	.13
8.57	1.9	2.0	2.1	2.2	2.3	2.5	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5	.12
10.0	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	.10
12.0	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4	2.5	0.08
15.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	.07
20.0	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	.05
30.0	.5	.6	.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	.03
60.0	.3	.3	.3	.3	.3	.4	.4	.4	.4	.4	.4	.5	.5	0.5	0.5	.02

δ	$\Delta h_1 : \Delta h_2$														
	1.00	1.05	1.10	1.15	1.20	1.25	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
20	+10	+ 2	− 5	−12	−17	−22	−27	−33	−39	−43	−46	−48	−50	−52	−55
21	+11	+ 3	− 4	−10	−16	−21	−25	−31	−37	−41	−44	−47	−49	−50	−53
22	+11	+ 4	− 3	− 9	−14	−19	−23	−30	−35	−39	−42	−45	−47	−49	−52
23	+12	+ 5	− 2	− 7	−13	−17	−21	−28	−33	−37	−40	−43	−45	−47	−50
24	+12	+ 6	0	− 6	−11	−16	−20	−26	−31	−35	−39	−41	−44	−45	−49
25	+13	+ 6	0	− 5	−10	−14	−18	−24	−30	−34	−37	−40	−42	−44	−47
26	+13	+ 7	+ 1	− 4	− 9	−13	−16	−23	−28	−32	−35	−38	−40	−42	−45
27	+14	+ 8	+ 2	− 3	− 7	−11	−15	−21	−26	−30	−34	−37	−39	−41	−44
28	+14	+ 8	+ 3	− 2	− 6	−10	−13	−20	−25	−29	−32	−35	−37	−39	−42
29	+15	+ 9	+ 4	− 1	− 5	− 9	−12	−18	−23	−27	−31	−33	−36	−38	−43
30	+15	+10	+ 5	0	− 4	− 8	−11	−17	−22	−26	−29	−32	−34	−36	−39
31	+16	+11	+ 6	+ 1	− 3	− 6	− 9	−15	−20	−24	−28	−31	−33	−35	−38
32	+16	+11	+ 7	+ 2	− 2	− 5	− 8	−14	−19	−23	−26	−29	−31	−33	−37
33	+17	+12	+ 7	+ 3	− 1	− 4	− 7	−13	−18	−21	−25	−27	−30	−32	−36
34	+17	+12	+ 8	+ 4	0	− 3	− 6	−12	−16	−20	−23	−26	−28	−30	−34
35	+18	+13	+ 9	+ 5	+ 1	− 2	− 5	−10	−15	−19	−22	−25	−27	−29	−33
36	+18	+14	+10	+ 6	+ 2	− 1	− 4	− 9	−14	−17	−21	−23	−26	−28	−31
37	+19	+14	+10	+ 7	+ 3	0	− 3	− 8	−12	−16	−19	−22	−24	−26	−30
38	+19	+15	+11	+ 8	+ 4	+ 1	− 2	− 7	−11	−15	−18	−21	−23	−25	−28
39	+20	+15	+12	+ 8	+ 5	+ 2	− 1	− 6	−10	−14	−17	−19	−22	−24	−27
40	+20	+16	+13	+ 9	+ 6	+ 3	0	− 5	− 9	−12	−15	−18	−20	−22	−26
41	+21	+17	+13	+10	+ 7	+ 4	+ 1	− 4	− 8	−11	−14	−17	−19	−21	−25
42	+21	+17	+14	+11	+ 8	+ 5	+ 2	− 2	− 7	−10	−13	−16	−18	−20	−23
43	+22	+18	+15	+12	+ 9	+ 6	+ 3	− 1	− 5	− 9	−12	−14	−17	−19	−22
44	+22	+18	+15	+12	+ 9	+ 7	+ 4	0	− 4	− 8	−11	−13	−16	−18	−21
45	+23	+19	+16	+13	+10	+ 7	+ 5	+ 1	− 3	− 7	−10	−12	−14	−16	−20
46	+23	+20	+17	+14	+11	+ 8	+ 6	+ 2	− 2	− 6	− 8	−11	−13	−15	−18
47	+24	+20	+17	+14	+12	+ 9	+ 7	+ 3	− 1	− 4	− 7	−10	−12	−14	−17
48	+24	+21	+18	+15	+12	+10	+ 8	+ 3	0	− 3	− 6	− 9	−11	−13	−16
49	+25	+21	+19	+16	+13	+11	+ 9	+ 4	+ 1	− 2	− 5	− 8	−10	−12	−15
50	+25	+22	+19	+16	+14	+12	+ 9	+ 5	+ 2	− 1	− 4	− 6	− 9	−11	−14
51	+26	+23	+20	+17	+15	+12	+10	+ 6	+ 3	0	− 3	− 5	− 8	− 9	−13
52	+26	+23	+20	+18	+15	+13	+11	+ 7	+ 4	+ 1	− 2	− 4	− 6	− 8	−12
53	+27	+24	+21	+19	+16	+14	+12	+ 8	+ 5	+ 2	− 1	− 3	− 5	− 7	−10
54	+27	+24	+22	+19	+17	+15	+13	+ 9	+ 6	+ 3	0	− 2	− 4	− 6	− 9
55	+28	+25	+22	+20	+18	+15	+13	+10	+ 6	+ 4	+ 1	− 1	− 3	− 5	− 8
56	+28	+25	+23	+21	+18	+16	+14	+11	+ 7	+ 5	+ 2	0	− 2	− 4	− 7
57	+29	+26	+23	+21	+19	+17	+15	+11	+ 8	+ 5	+ 3	+ 1	− 1	− 3	− 6
58	+29	+26	+24	+22	+20	+18	+16	+12	+ 9	+ 6	+ 4	+ 2	0	− 2	− 5
59	+30	+27	+25	+22	+20	+18	+17	+13	+10	+ 7	+ 5	+ 3	+ 1	− 1	− 4
60	+30	+28	+25	+23	+21	+19	+17	+14	+11	+ 8	+ 6	+ 4	+ 2	0	− 3
61	+31	+28	+26	+24	+22	+20	+18	+15	+12	+ 9	+ 7	+ 5	+ 3	+ 1	− 2
62	+31	+29	+26	+24	+22	+21	+19	+16	+13	+10	+ 8	+ 6	+ 4	+ 2	− 1
63	+32	+29	+27	+25	+23	+21	+19	+16	+13	+11	+ 9	+ 7	+ 5	+ 3	0
64	+32	+30	+28	+26	+24	+22	+20	+17	+14	+12	+ 9	+ 7	+ 6	+ 4	+ 1
65	+33	+30	+28	+26	+24	+23	+21	+18	+15	+13	+10	+ 8	+ 7	+ 5	+ 2
66	+33	+31	+29	+27	+25	+23	+22	+19	+16	+13	+11	+ 9	+ 7	+ 6	+ 3
67	+34	+31	+29	+27	+26	+24	+22	+19	+17	+14	+12	+10	+ 8	+ 7	+ 4
68	+34	+32	+30	+28	+26	+25	+23	+20	+17	+15	+13	+11	+ 9	+ 8	+ 5
69	+35	+32	+31	+29	+27	+25	+24	+21	+18	+16	+14	+12	+10	+ 9	+ 6
70	+35	+33	+31	+29	+28	+26	+24	+22	+19	+17	+15	+13	+11	+10	+ 7

δ	Δh : Δh														
	2.4	2.6	2.8	3.0	3.5	4.0	4.5	5	6	7	8	10	15	20	$\frac{x}{0}$
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
20	−57	−58	−60	−61	−62	−64	−65	−65	−66	−67	−67	−68	−69	−69	−70
21	−55	−57	−58	−59	−61	−62	−63	−64	−65	−66	−66	−67	−67	−68	−69
22	−54	−56	−57	−58	−60	−61	−62	−63	−64	−64	−65	−66	−66	−67	−68
23	−52	−54	−55	−56	−58	−60	−61	−62	−63	−63	−64	−65	−65	−66	−67
24	−51	−52	−54	−55	−57	−58	−60	−60	−61	−62	−63	−63	−64	−65	−66
25	−49	−51	−52	−53	−55	−57	−58	−59	−60	−61	−62	−62	−63	−64	−65
26	−48	−50	−51	−52	−54	−56	−57	−58	−59	−60	−61	−61	−62	−63	−64
27	−46	−48	−50	−51	−53	−55	−56	−57	−58	−59	−59	−60	−61	−62	−63
28	−45	−47	−48	−49	−51	−53	−55	−55	−56	−57	−58	−59	−60	−60	−62
29	−44	−45	−47	−48	−50	−52	−53	−54	−55	−56	−57	−58	−59	−59	−61
30	−42	−44	−46	−47	−49	−51	−52	−53	−54	−55	−56	−57	−58	−58	−60
31	−41	−43	−44	−45	−48	−50	−51	−52	−53	−54	−55	−56	−57	−57	−59
32	−39	−41	−43	−44	−47	−48	−50	−51	−52	−53	−54	−55	−56	−56	−58
33	−38	−40	−41	−43	−45	−47	−49	−50	−51	−52	−53	−54	−55	−55	−57
34	−36	−38	−40	−42	−44	−46	−47	−48	−50	−51	−52	−53	−54	−54	−56
35	−35	−37	−39	−40	−43	−45	−46	−47	−49	−50	−50	−51	−53	−53	−55
36	−34	−36	−38	−39	−42	−44	−45	−46	−48	−49	−49	−50	−52	−52	−54
37	−32	−35	−36	−38	−40	−42	−44	−45	−46	−47	−48	−49	−51	−51	−53
38	−31	−33	−35	−36	−39	−41	−43	−44	−45	−46	−47	−48	−50	−50	−52
39	−30	−32	−34	−35	−38	−40	−41	−43	−44	−45	−46	−47	−48	−49	−51
40	−29	−31	−32	−34	−37	−39	−40	−41	−43	−44	−45	−46	−47	−48	−50
41	−27	−29	−31	−33	−36	−38	−39	−40	−42	−43	−44	−45	−46	−47	−49
42	−26	−28	−30	−31	−34	−36	−38	−39	−41	−42	−43	−44	−45	−46	−48
43	−25	−27	−29	−30	−33	−35	−37	−38	−40	−41	−42	−43	−44	−45	−47
44	−24	−26	−28	−29	−32	−34	−36	−37	−39	−40	−41	−42	−43	−44	−46
45	−22	−25	−26	−28	−31	−33	−34	−36	−37	−39	−39	−41	−42	−43	−45
46	−21	−23	−25	−27	−30	−32	−33	−35	−36	−37	−38	−40	−41	−42	−44
47	−20	−22	−24	−25	−28	−31	−32	−33	−35	−36	−37	−39	−40	−41	−43
48	−19	−21	−23	−24	−27	−29	−31	−32	−34	−35	−36	−37	−39	−40	−42
49	−18	−20	−22	−23	−26	−28	−30	−31	−33	−34	−35	−36	−38	−39	−41
50	−16	−19	−20	−22	−25	−27	−29	−30	−32	−33	−34	−35	−37	−38	−40
51	−15	−17	−19	−21	−24	−26	−28	−29	−31	−32	−33	−34	−36	−37	−39
52	−14	−16	−18	−20	−23	−25	−27	−28	−30	−31	−32	−33	−35	−36	−38
53	−13	−15	−17	−19	−22	−24	−25	−27	−29	−30	−31	−32	−34	−35	−37
54	−12	−14	−16	−17	−20	−23	−24	−26	−27	−29	−30	−31	−33	−34	−36
55	−11	−13	−15	−16	−19	−22	−23	−25	−26	−28	−29	−30	−32	−33	−35
56	−10	−12	−14	−15	−18	−20	−22	−23	−25	−27	−28	−29	−31	−32	−34
57	− 9	−11	−13	−14	−17	−19	−21	−22	−24	−26	−27	−28	−30	−31	−33
58	− 8	−10	−12	−13	−16	−18	−20	−21	−23	−25	−26	−27	−29	−30	−32
59	− 7	− 9	−10	−12	−15	−17	−19	−20	−22	−23	−24	−26	−28	−28	−31
60	− 5	− 8	− 9	−11	−14	−16	−18	−19	−21	−22	−23	−25	−27	−27	−30
61	− 4	− 7	− 8	−10	−13	−15	−17	−18	−20	−21	−22	−24	−26	−26	−29
62	− 3	− 5	− 7	− 9	−12	−14	−16	−17	−19	−20	−21	−23	−25	−25	−28
63	− 2	− 4	− 6	− 8	−11	−13	−15	−16	−18	−19	−20	−22	−24	−24	−27
64	− 1	− 3	− 5	− 7	−10	−12	−14	−15	−17	−18	−19	−21	−23	−23	−26
65	0	− 2	− 4	− 6	− 9	−11	−12	−14	−16	−17	−18	−20	−21	−22	−25
66	+ 1	− 1	− 3	− 5	− 8	−10	−11	−13	−15	−16	−17	−19	−20	−21	−24
67	+ 2	0	− 2	− 4	− 7	− 9	−10	−12	−14	−15	−16	−18	−19	−20	−23
68	+ 3	+ 1	− 1	− 3	− 5	− 8	− 9	−11	−13	−14	−15	−16	−18	−19	−22
69	+ 4	+ 2	0	− 2	− 4	− 7	− 8	−10	−12	−13	−14	−15	−17	−18	−21
70	+ 5	+ 3	+ 1	− 1	− 3	− 6	− 7	− 9	−11	−12	−13	−14	−16	−17	−20

δ	$\Delta h_1 : \Delta h_2$														
	1.00	1.05	1.10	1.15	1.20	1.25	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
70	+35	+33	+31	+29	+28	+26	+24	+22	+19	+17	+15	+13	+11	+10	+ 7
71	+36	+34	+32	+30	+28	+27	+25	+22	+20	+18	+16	+14	+12	+10	+ 8
72	+36	+34	+32	+31	+29	+27	+26	+23	+21	+18	+16	+15	+13	+11	+ 9
73	+37	+35	+33	+31	+29	+28	+27	+24	+21	+19	+17	+15	+14	+12	+10
74	+37	+35	+33	+32	+30	+29	+27	+25	+22	+20	+18	+16	+15	+13	+11
75	+38	+36	+34	+32	+31	+29	+28	+25	+23	+21	+19	+17	+15	+14	+11
76	+38	+36	+35	+33	+31	+30	+29	+26	+24	+22	+20	+18	+16	+15	+12
77	+39	+37	+35	+33	+32	+31	+29	+27	+24	+22	+20	+19	+17	+16	+13
78	+39	+37	+36	+34	+33	+31	+30	+27	+25	+23	+21	+20	+18	+17	+14
79	+40	+38	+36	+35	+33	+32	+31	+28	+26	+24	+22	+20	+19	+17	+15
80	+40	+38	+37	+35	+34	+32	+31	+29	+27	+25	+23	+21	+20	+18	+16
81	+41	+39	+37	+36	+34	+33	+32	+29	+27	+25	+24	+22	+21	+19	+17
82	+41	+39	+38	+36	+35	+34	+32	+30	+28	+26	+24	+23	+21	+20	+18
83	+42	+40	+38	+37	+36	+34	+33	+31	+29	+27	+25	+24	+22	+21	+19
84	+42	+40	+39	+38	+36	+35	+34	+31	+29	+28	+26	+24	+23	+22	+19
85	+43	+41	+40	+38	+37	+36	+34	+32	+30	+28	+27	+25	+24	+23	+20
86	+43	+42	+40	+39	+37	+36	+35	+33	+31	+29	+27	+26	+25	+23	+21
87	+44	+42	+41	+39	+38	+37	+36	+34	+32	+30	+28	+27	+25	+24	+22
88	+44	+43	+41	+40	+39	+37	+36	+34	+32	+31	+29	+28	+26	+25	+23
89	+45	+43	+42	+40	+39	+38	+37	+35	+33	+31	+30	+28	+27	+26	+24
90	+45	+44	+42	+41	+40	+39	+38	+36	+34	+32	+30	+29	+28	+27	+24
91	+46	+44	+43	+42	+40	+39	+38	+36	+34	+33	+31	+30	+29	+27	+25
92	+46	+45	+43	+42	+41	+40	+39	+37	+35	+33	+32	+31	+29	+28	+26
93	+47	+45	+44	+43	+42	+40	+39	+38	+36	+34	+33	+31	+30	+29	+27
94	+47	+46	+44	+43	+42	+41	+40	+38	+36	+35	+33	+32	+31	+30	+28
95	+48	+46	+45	+44	+43	+42	+41	+39	+37	+36	+34	+33	+32	+31	+29
96	+48	+47	+46	+44	+43	+42	+41	+39	+38	+36	+35	+34	+32	+31	+29
97	+49	+47	+46	+45	+44	+43	+42	+40	+38	+37	+36	+34	+33	+32	+30
98	+49	+48	+47	+46	+44	+43	+43	+41	+39	+38	+36	+35	+34	+33	+31
99	+50	+48	+47	+46	+45	+44	+43	+41	+40	+38	+37	+36	+35	+34	+32
100	+50	+49	+48	+47	+46	+45	+44	+42	+40	+39	+38	+37	+35	+34	+33
101	+51	+49	+48	+47	+46	+45	+44	+43	+41	+40	+38	+37	+36	+35	+33
102	+51	+50	+49	+48	+47	+46	+45	+43	+42	+40	+39	+38	+37	+36	+34
103	+52	+50	+49	+48	+47	+46	+46	+44	+42	+41	+40	+39	+38	+37	+35
104	+52	+51	+50	+49	+48	+47	+46	+45	+43	+42	+41	+39	+38	+37	+36
105	+53	+51	+50	+49	+49	+48	+47	+45	+44	+42	+41	+40	+39	+38	+36
106	+53	+52	+51	+50	+49	+48	+47	+46	+44	+43	+42	+41	+40	+39	+37
107	+54	+52	+51	+51	+50	+49	+48	+46	+45	+44	+43	+42	+41	+40	+38
108	+54	+53	+52	+51	+50	+49	+49	+47	+46	+44	+43	+42	+41	+40	+39
109	+55	+53	+53	+52	+51	+50	+49	+48	+46	+45	+44	+43	+42	+41	+40
110	+55	+54	+53	+52	+51	+51	+50	+48	+47	+46	+45	+44	+43	+42	+40
111	+56	+55	+54	+53	+52	+51	+50	+49	+48	+46	+45	+44	+43	+43	+41
112	+56	+55	+54	+53	+52	+52	+51	+50	+48	+47	+46	+45	+44	+43	+42
113	+57	+56	+55	+54	+53	+52	+52	+50	+49	+48	+47	+46	+45	+44	+43
114	+57	+56	+55	+54	+54	+53	+52	+51	+50	+48	+47	+46	+46	+45	+43
115	+58	+57	+56	+55	+54	+53	+53	+51	+50	+49	+48	+47	+46	+46	+44

δ	$\Delta h_1 : \Delta h_2$														
	2.4	2.6	2.8	3.0	3.5	4.0	4.5	5	6	7	8	10	15	20	$\frac{x}{0}$
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
70	+ 5	+ 3	+ 1	— 1	— 3	— 6	— 7	— 9	—11	—12	—13	—14	—16	—17	—20
71	+ 6	+ 4	+ 2	0	— 2	— 5	— 6	— 8	—10	—11	—12	—13	—15	—16	—19
72	+ 7	+ 5	+ 3	+ 1	— 1	— 4	— 5	— 7	— 9	—10	—11	—12	—14	—15	—18
73	+ 8	+ 5	+ 4	+ 2	0	— 3	— 4	— 6	— 7	— 9	—10	—11	—13	—14	—17
74	+ 9	+ 6	+ 5	+ 3	+ 1	— 2	— 3	— 4	— 6	— 8	— 9	—10	—12	—13	—16
75	+10	+ 7	+ 6	+ 4	+ 2	— 1	— 2	— 3	— 5	— 7	— 8	— 9	—11	—12	—15
76	+10	+ 8	+ 7	+ 5	+ 3	0	— 1	— 2	— 4	— 6	— 7	— 8	—10	—11	—14
77	+11	+ 9	+ 8	+ 6	+ 4	+ 1	0	— 1	— 3	— 5	— 6	— 7	— 9	—10	—13
78	+12	+10	+ 9	+ 7	+ 5	+ 2	+ 1	0	— 2	— 4	— 5	— 6	— 8	— 9	—12
79	+13	+11	+10	+ 8	+ 6	+ 3	+ 2	+ 1	— 1	— 3	— 4	— 5	— 7	— 8	—11
80	+14	+12	+11	+ 9	+ 7	+ 4	+ 3	+ 2	0	— 2	— 3	— 4	— 6	— 7	—10
81	+15	+13	+12	+10	+ 7	+ 5	+ 4	+ 3	+ 1	— 1	— 2	— 3	— 5	— 6	— 9
82	+16	+14	+12	+11	+ 8	+ 6	+ 5	+ 4	+ 2	0	— 1	— 2	— 4	— 5	— 8
83	+17	+15	+13	+12	+ 9	+ 7	+ 6	+ 5	+ 3	+ 1	0	— 1	— 3	— 4	— 7
84	+17	+16	+14	+13	+10	+ 8	+ 7	+ 6	+ 4	+ 2	+ 1	0	— 2	— 3	— 6
85	+18	+17	+15	+14	+11	+ 9	+ 8	+ 6	+ 5	+ 3	+ 2	+ 1	— 1	— 2	— 5
86	+19	+18	+16	+15	+12	+10	+ 9	+ 7	+ 6	+ 4	+ 3	+ 2	0	— 1	— 4
87	+20	+18	+17	+16	+13	+11	+10	+ 8	+ 7	+ 5	+ 4	+ 3	+ 1	0	— 3
88	+21	+19	+18	+17	+14	+12	+11	+ 9	+ 8	+ 6	+ 5	+ 4	+ 2	+ 1	— 2
89	+22	+20	+19	+18	+15	+13	+12	+10	+ 8	+ 7	+ 6	+ 5	+ 3	+ 2	— 1
90	+23	+21	+20	+18	+16	+14	+13	+11	+ 9	+ 8	+ 7	+ 6	+ 4	+ 3	0
91	+23	+22	+21	+19	+17	+15	+13	+12	+10	+ 9	+ 8	+ 7	+ 5	+ 4	+ 1
92	+24	+23	+21	+20	+18	+16	+14	+13	+11	+10	+ 9	+ 8	+ 6	+ 5	+ 2
93	+25	+24	+22	+21	+19	+17	+15	+14	+12	+11	+10	+ 9	+ 7	+ 6	+ 3
94	+26	+24	+23	+22	+20	+18	+16	+15	+13	+12	+11	+10	+ 8	+ 7	+ 4
95	+27	+25	+24	+23	+21	+19	+17	+16	+14	+13	+12	+11	+ 9	+ 8	+ 5
96	+28	+26	+25	+24	+21	+20	+18	+17	+15	+14	+13	+12	+10	+ 9	+ 6
97	+28	+27	+26	+25	+22	+21	+19	+18	+16	+15	+14	+13	+11	+10	+ 7
98	+29	+28	+27	+26	+23	+21	+20	+19	+17	+16	+15	+14	+12	+11	+ 8
99	+30	+29	+27	+26	+24	+22	+21	+20	+18	+17	+16	+15	+13	+12	+ 9
100	+31	+30	+28	+27	+25	+23	+22	+21	+19	+18	+17	+16	+14	+13	+10
101	+32	+30	+29	+28	+26	+24	+23	+22	+20	+19	+18	+17	+15	+14	+11
102	+33	+31	+30	+29	+27	+25	+24	+23	+21	+20	+19	+18	+16	+15	+12
103	+33	+32	+31	+30	+28	+26	+25	+24	+22	+21	+20	+18	+17	+16	+13
104	+34	+33	+32	+31	+29	+27	+26	+24	+23	+22	+21	+19	+18	+17	+14
105	+35	+34	+33	+32	+30	+28	+26	+25	+24	+23	+22	+20	+19	+18	+15
106	+36	+34	+33	+32	+30	+29	+27	+26	+25	+24	+23	+21	+20	+19	+16
107	+37	+35	+34	+33	+31	+30	+28	+27	+26	+24	+24	+22	+21	+20	+17
108	+37	+36	+35	+34	+32	+30	+29	+28	+27	+25	+24	+23	+22	+21	+18
109	+38	+37	+36	+35	+33	+31	+30	+29	+27	+26	+25	+24	+23	+22	+19
110	+39	+38	+37	+36	+34	+32	+31	+30	+28	+27	+26	+25	+23	+23	+20
111	+40	+39	+38	+37	+35	+33	+32	+31	+29	+28	+27	+26	+24	+24	+21
112	+40	+39	+38	+37	+36	+34	+33	+32	+30	+29	+28	+27	+25	+25	+22
113	+41	+40	+39	+38	+36	+35	+34	+33	+31	+30	+29	+28	+26	+26	+23
114	+42	+41	+40	+39	+37	+36	+35	+34	+32	+31	+30	+29	+27	+27	+24
115	+43	+42	+41	+40	+38	+37	+35	+34	+33	+32	+31	+30	+28	+28	+25

δ	$\Delta h_1 : \Delta h_2$														
	1.00	1.05	1.10	1.15	1.20	1.25	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
115	+58	+57	+56	+55	+54	+53	+53	+51	+50	+49	+48	+47	+46	+46	+44
116	+58	+57	+56	+56	+55	+54	+53	+52	+51	+50	+49	+48	+47	+46	+45
117	+59	+58	+57	+56	+55	+55	+54	+53	+52	+50	+49	+49	+48	+47	+46
118	+59	+58	+57	+57	+56	+55	+55	+53	+52	+51	+50	+49	+48	+48	+46
119	+60	+59	+58	+57	+56	+56	+55	+54	+53	+52	+51	+50	+49	+48	+47
120	+60	+59	+58	+58	+57	+56	+56	+55	+53	+52	+51	+51	+50	+49	+48
121	+61	+60	+59	+58	+58	+57	+56	+55	+54	+53	+52	+51	+51	+50	+49
122	+61	+60	+59	+59	+58	+57	+57	+56	+55	+54	+53	+52	+51	+51	+49
123	+62	+61	+60	+59	+59	+58	+57	+56	+55	+54	+53	+53	+52	+51	+50
124	+62	+61	+61	+60	+59	+59	+58	+57	+56	+55	+54	+53	+53	+52	+51
125	+63	+62	+61	+60	+60	+59	+59	+58	+57	+56	+55	+54	+53	+53	+51
126	+63	+62	+62	+61	+60	+60	+59	+58	+57	+56	+55	+55	+54	+53	+52
127	+64	+63	+62	+62	+61	+60	+60	+59	+58	+57	+56	+55	+55	+54	+53
128	+64	+63	+63	+62	+61	+61	+60	+59	+58	+58	+57	+56	+55	+55	+54
129	+65	+64	+63	+63	+62	+61	+61	+60	+59	+58	+57	+57	+56	+55	+54
130	+65	+64	+64	+63	+63	+62	+62	+61	+60	+59	+58	+57	+57	+56	+55
131	+66	+65	+64	+64	+63	+63	+62	+61	+60	+59	+59	+58	+57	+57	+56
132	+66	+65	+65	+64	+64	+63	+63	+62	+61	+60	+59	+59	+58	+58	+57
133	+67	+66	+65	+65	+64	+64	+63	+62	+62	+61	+60	+59	+59	+59	+57
134	+67	+66	+66	+65	+65	+64	+64	+63	+62	+61	+61	+60	+59	+59	+58
135	+68	+67	+66	+66	+65	+65	+64	+64	+63	+62	+61	+61	+60	+60	+59
136	+68	+67	+67	+66	+66	+65	+65	+64	+63	+63	+62	+61	+61	+60	+59
137	+69	+68	+67	+67	+66	+66	+66	+65	+64	+63	+63	+62	+62	+61	+60
138	+69	+68	+68	+67	+67	+67	+66	+65	+65	+64	+63	+63	+62	+62	+61
139	+70	+69	+68	+68	+68	+67	+67	+66	+65	+65	+64	+63	+63	+62	+62
140	+70	+69	+69	+69	+68	+68	+67	+67	+66	+65	+65	+64	+64	+63	+62
141	+71	+70	+70	+69	+69	+68	+68	+67	+66	+66	+65	+65	+64	+64	+63
142	+71	+71	+70	+70	+69	+69	+68	+68	+67	+66	+66	+65	+65	+64	+64
143	+72	+71	+71	+70	+70	+69	+69	+68	+68	+67	+67	+66	+66	+65	+64
144	+72	+72	+71	+71	+70	+70	+70	+69	+68	+68	+67	+67	+66	+66	+65
145	+73	+72	+72	+71	+71	+70	+70	+69	+69	+68	+68	+67	+67	+66	+66
146	+73	+73	+72	+72	+71	+71	+71	+70	+69	+69	+68	+68	+68	+67	+66
147	+74	+73	+73	+72	+72	+72	+71	+71	+70	+70	+69	+69	+68	+68	+67
148	+74	+74	+73	+73	+73	+72	+72	+71	+71	+70	+70	+69	+69	+69	+68
149	+75	+74	+74	+73	+73	+73	+72	+72	+71	+71	+70	+70	+70	+69	+69
150	+75	+75	+74	+74	+74	+73	+73	+72	+72	+71	+71	+71	+70	+70	+69
151	+76	+75	+75	+75	+74	+74	+74	+73	+73	+72	+72	+71	+71	+70	+70
152	+76	+76	+75	+75	+75	+74	+74	+74	+73	+73	+72	+72	+72	+71	+71
153	+77	+76	+76	+76	+75	+75	+75	+74	+74	+73	+73	+73	+72	+72	+71
154	+77	+77	+76	+76	+76	+75	+75	+75	+74	+74	+74	+73	+73	+73	+72
155	+78	+77	+77	+77	+76	+76	+76	+75	+75	+75	+74	+74	+74	+73	+73
156	+78	+78	+77	+77	+77	+77	+76	+76	+76	+75	+75	+75	+74	+74	+73
157	+79	+78	+78	+78	+77	+77	+77	+77	+76	+76	+76	+75	+75	+75	+74
158	+79	+79	+78	+78	+78	+78	+77	+77	+77	+76	+76	+76	+76	+75	+75
159	+80	+79	+79	+79	+79	+78	+78	+78	+77	+77	+77	+76	+76	+76	+75

δ	$\Delta h_1 : \Delta h_2$														
	2.4	2.6	2.8	3.0	3.5	4.0	4.5	5	6	7	8	10	15	20	$\frac{x}{0}$
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
115	+43	+42	+41	+40	+38	+37	+35	+34	+33	+32	+31	+30	+28	+28	+25
116	+44	+42	+42	+41	+39	+37	+36	+35	+34	+33	+32	+31	+29	+29	+26
117	+44	+43	+42	+41	+40	+38	+37	+36	+35	+34	+33	+32	+30	+29	+27
118	+45	+44	+43	+42	+41	+39	+38	+37	+36	+35	+34	+33	+31	+30	+28
119	+46	+45	+44	+43	+41	+40	+39	+38	+37	+36	+35	+34	+32	+31	+29
120	+47	+46	+45	+44	+42	+41	+40	+39	+38	+37	+36	+35	+33	+32	+30
121	+47	+46	+45	+45	+43	+42	+41	+40	+38	+38	+37	+36	+34	+33	+31
122	+48	+47	+46	+45	+44	+43	+42	+41	+39	+38	+38	+37	+35	+34	+32
123	+49	+48	+47	+46	+45	+43	+42	+42	+40	+39	+39	+38	+36	+35	+33
124	+50	+49	+48	+47	+46	+44	+43	+42	+41	+40	+40	+39	+37	+36	+34
125	+50	+49	+49	+48	+46	+45	+44	+43	+42	+41	+40	+39	+38	+37	+35
126	+51	+50	+49	+49	+47	+46	+45	+44	+43	+42	+41	+40	+39	+38	+36
127	+52	+51	+50	+50	+48	+47	+46	+45	+44	+43	+42	+41	+40	+39	+37
128	+53	+52	+51	+50	+49	+48	+47	+46	+45	+44	+43	+42	+41	+40	+38
129	+53	+53	+52	+51	+50	+49	+48	+47	+46	+45	+44	+43	+42	+41	+39
130	+54	+53	+53	+52	+50	+49	+48	+48	+47	+46	+45	+44	+43	+42	+40
131	+55	+54	+53	+53	+51	+50	+49	+49	+47	+47	+46	+45	+44	+43	+41
132	+56	+55	+54	+53	+52	+51	+50	+49	+48	+48	+47	+46	+45	+44	+42
133	+56	+56	+55	+54	+53	+52	+51	+50	+49	+48	+48	+47	+46	+45	+43
134	+57	+57	+56	+55	+54	+53	+52	+51	+50	+49	+49	+48	+47	+46	+44
135	+58	+57	+56	+56	+55	+54	+53	+52	+51	+50	+50	+49	+48	+47	+45
136	+59	+58	+57	+57	+55	+54	+54	+53	+52	+51	+51	+50	+49	+48	+46
137	+59	+59	+58	+57	+56	+55	+54	+54	+53	+52	+51	+51	+49	+49	+47
138	+60	+59	+59	+58	+57	+56	+55	+55	+54	+53	+52	+52	+50	+50	+48
139	+61	+60	+59	+59	+58	+57	+56	+56	+55	+54	+53	+52	+51	+51	+49
140	+61	+61	+60	+60	+59	+58	+57	+56	+55	+55	+54	+53	+52	+52	+50
141	+62	+62	+61	+60	+59	+59	+58	+57	+56	+56	+55	+54	+53	+53	+51
142	+63	+62	+62	+61	+60	+59	+59	+58	+57	+57	+56	+55	+54	+54	+52
143	+64	+63	+62	+62	+61	+60	+60	+59	+58	+57	+57	+56	+55	+55	+53
144	+64	+64	+63	+63	+62	+61	+60	+60	+59	+58	+58	+57	+56	+56	+54
145	+65	+65	+64	+64	+63	+62	+61	+60	+60	+59	+59	+58	+57	+57	+55
146	+66	+65	+65	+64	+63	+63	+62	+61	+61	+60	+60	+59	+58	+58	+56
147	+67	+66	+66	+65	+64	+64	+63	+62	+62	+61	+61	+60	+59	+59	+57
148	+67	+67	+66	+66	+65	+64	+64	+63	+62	+62	+61	+61	+60	+60	+58
149	+68	+67	+67	+67	+66	+65	+64	+64	+63	+63	+62	+62	+61	+61	+59
150	+69	+68	+68	+67	+67	+66	+65	+65	+64	+64	+63	+63	+62	+62	+60
151	+70	+69	+69	+68	+68	+67	+66	+66	+65	+65	+64	+63	+63	+62	+61
152	+70	+70	+69	+69	+68	+67	+67	+67	+66	+66	+65	+64	+64	+63	+62
153	+71	+70	+70	+70	+69	+68	+68	+68	+67	+67	+66	+65	+65	+64	+63
154	+72	+71	+71	+70	+70	+69	+69	+68	+68	+67	+67	+66	+66	+65	+64
155	+72	+72	+72	+71	+71	+70	+70	+69	+68	+68	+68	+67	+67	+66	+65
156	+73	+73	+72	+72	+71	+71	+70	+70	+69	+69	+69	+68	+68	+67	+66
157	+74	+73	+73	+73	+72	+72	+71	+71	+70	+70	+69	+69	+68	+68	+67
158	+74	+74	+74	+73	+73	+72	+72	+72	+71	+71	+70	+70	+69	+69	+68
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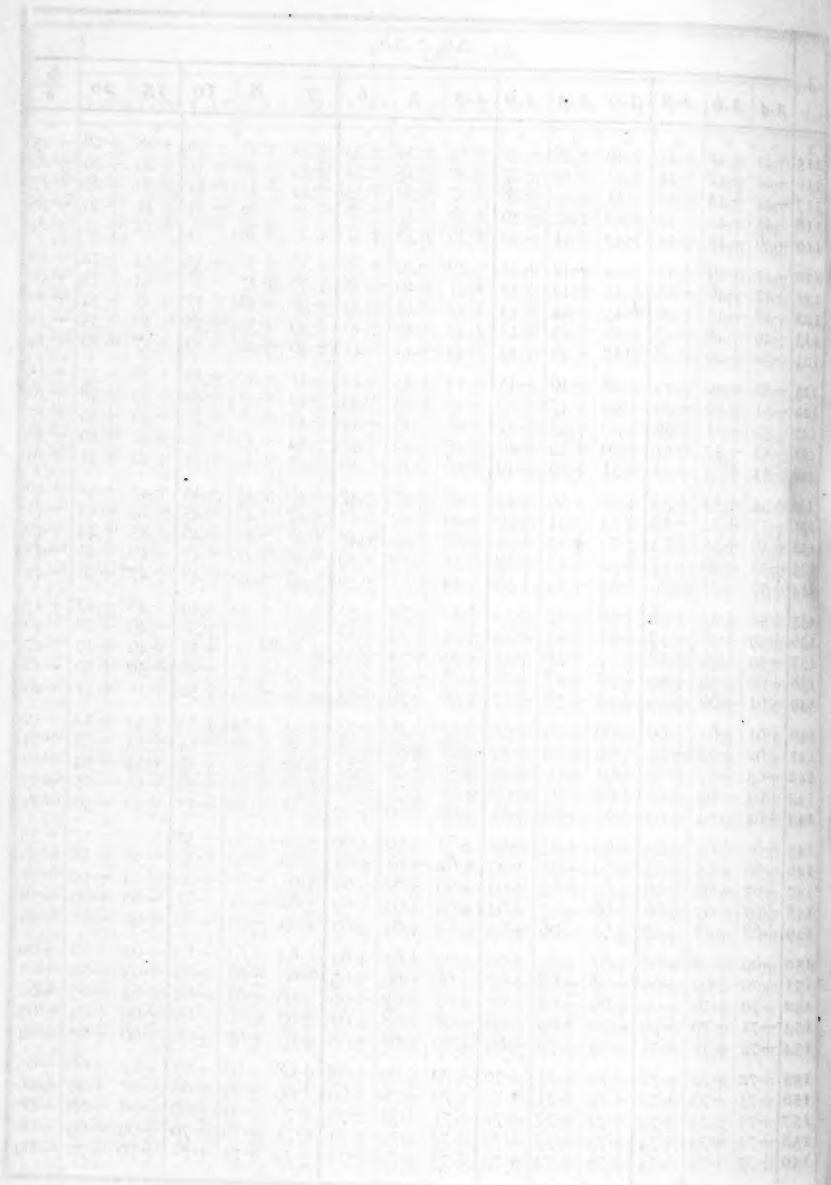

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SEARLE'S METHOD OF FINDING A SHIP'S POSITION.

By LIEUT. COMMANDER HARRIS LANING, U. S. Navy.

I have recently been handed a small book entitled "Sumner's Method for Finding a Ship's Position," by Rev. G. M. Searle, Director of the Observatory, Catholic University, and formerly a Professor in the Department of Mathematics at the U. S. Naval Academy. The book is published by D. Van Nostrand Co., New York (price fifty cents). It provides a means of computing the intersection of two Sumner's lines without solving for each line separately—a method that I have not before seen used and which seems to me to be more simple than any other method of computing intersections with which I am familiar. I believe that navigators who desire to get a fix from two observations with a run between will find this method to be advantageous, and this article is submitted with a view to calling their attention to it.

The author gives first a practical method of working the sights out and follows with a deduction of the formulæ involved. I will not endeavor to do more than explain the practical side of the work. The fix may be determined either at the time of the first sight or at the time of the second sight. Inasmuch as the position at the second sight is the one usually desired, the auther has developed a form with that in view. The altitude of the first sight is corrected in such a way that it has the value it would have had had the first observation been made at the same time but at the second place, but with the sun's declination as it was at the other place. The theory involved is rather complicated, but the practical working results are comparatively simple.

The nomenclature and form given by the author differ from the nomenclature and form ordinarily used by officers of the navy. I have therefore changed both to make the method more easily understood. The nomenclature is as follows:

h = true altitude at first observation.

h_1 = true altitude of first observation corrected to be what it would have been at the second place, at its own actual time, with the sun's declination as it was at the other place.

h_2 = true altitude at second observation.

L = approximate latitude (by dead reckoning) of first observation.

d_1 = declination at time of first observation.

d_2 = declination at time of second observation.

Δd = change of declination between the two observations.

az = azimuth of the sun at the first observation.

c = course between the two points of observation.

r = run in knots between the two observations.

a = the position angle.

T_d = half the interval of time between observations, reduced to arc.

T = the mean of the Greenwich approximate times of the two observations, reduced to arc.

t = hour angle.

Z_1 = zenith distance of first observation, corrected for position of second observation.

Z_2 = zenith distance at second observation.

Z = half the sum of the above zenith distances.

z = half the difference of the above zenith distances.

The formulæ used are as follows:

(1) Correction to first altitude for run $= r \cos (az - c)$. This correction is negative when $az - b$ is between 90° and 270°.

(2) Correction in first altitude for change in declination $= \Delta d \cos a$.

(3) $\text{Cos } a = \dfrac{\sin L - \sin d_1 \sin h}{\cos d_1 \sin h}$ and is positive in north latitudes and negative in south latitudes unless the declination has the same sign as the latitude and $\sin d_1 \sin h$ is numerically greater than $\sin L$.

(4) $Z_1 = 90° - (h + \{r \cos (az - c) + \Delta d \cos a\}.)$

(5) $Z_2 = 90° - h_2$.

(6) $\tan A = \cot d_2 \cot T_d$.

(7) $\tan B = \tan Z \tan z \cot T_d \operatorname{cosec} A$.

(8) $\cos C = \sin Z \sin z \operatorname{cosec} T_d \sec d_2 \operatorname{cosec} B$.

(9) $\sin L = \cos A \cos B \cos C \pm \sin A \sin C$.

(10) $\sin t = \sin B \cos C \sec L$.

(11) long. $= T - t$, in west longitudes.

(12) long. $= t - T$, in east longitudes.

Problem.

On May 7, 1909, at w. t. 3–38–24 observed altitude of sun 47°–12′–30″. c–w, 2–08–10; c. c. + 1 min. 30.2 sec. c.; height of eye 40 ft.; I. C. + 1′–30″; azimuth of sun observed and corrected 247°; approximate latitude 71°–10′ N.; approximate longitude 47° W.

Thence ran 12.3 miles on course 30° (true) when at w. t. 5–20–26 observed ⊙ 28°–28′–23″.

To find the latitude and longitude at time of second observation.

SOLUTION.

FIRST OBSERVATION.

w. t. 3–38–24	⊙ 47–12–30	I. C. + 1–30	Dec. 16–42–46.1 N.	H. D. + 41.65″	Eq. T. + 3–32.8	H. D. + .186
c–w 2–08–10	corr. + 10–23	S. D. + 15–53	Corr. + 4–01.6	5.8	Corr. 1.1	5.8
c. T. 5–46–34.	h=47–22–53	Dip. — 6–12	d_1 16–46–47.7	241.6	Eq. T. + 3–33.9	1.08
c. c. + 1–30.2		P. & R. — 0–48		4–01.6		
G. M. T. 5–48–04.2		Corr. + 10–23				
Eq. T. 3–33.9						
G. A. T. 5–51–38.1						

SECOND OBSERVATION.

w. t. 5–20–26	⊙ 28–28–23	I. C. + 1–30	Dec. 16–42–46.1	H. D. + 41.65	Eq. T.	3–32.8	H. D. + .186
c–w 2–08–10	corr. + 9–31	S. D. + 15–53	Corr. + 5–12.4	7.5	Corr.	+ 1.4	7.5
c. t. 7–28–36	h_2=28–37–54	Dip. — 6–12	d_2=16–47–58.5	+ 312.375	Eq. T.	3–34.2	+1.3950
c. c. + 1–30.2	Z_2=61–22–06	P. & R. — 1–40	d_1 16–46–47.7	+ 5–12.4			
G. M. T. 7–30–06.2		Corr. + 9–31	Δd=1′—10.8″=1.18′				
Eq. T. 3–34.2							
G. A. T. 7–33–40.4							

L=41–10′ N. az=247° c=30° $az - c$=217° r=12.3 $r\cos(az-c)$=−9.82 $\Delta d \cos a$=+.81

cos −9.90235 log 1.08991 log −0.99226

Corr. to 1st alt. = −8.91′ = −8′ − 54″

h= 47–22–53

h_1= 47–13–59

Z_1= 42–46–01

Z_2= 61–22–06

$Z=\frac{1}{2}(Z_1+Z_2)$= 52–04–03.5

L= 41–10 N. az= 247° d_1=16–46–47.7 a=46–22–05 Δd= 1.18′

cos 9.87668 sin 9.96403 log 9.84071 cos 9.98110 sin 9.85961 cos 9.83886 log 0.07188 log 9.91074

1st G. A. T. 7–33–40.4

2d G. A. T. 5–51–38.1

Mean G. A. T. 6–42–39.2 = 100°–39′–48″ = T

½ diff. between G. A. T. 0–51–01.1 = 12°–45′–16.5″ = Td

$z=\frac{1}{2}[Z_1 - Z_2]$=9–18–02.5

$\frac{1}{2}c$=0–45 cot 0.52012 sec .01894

Td=12–45–16.5 cos 9.98915 cot 0.64520 cosec 0.65605

A=72–48–00 tan 0.50927 cosec 0.01987 cos 9.47086 sin 9.98013

Z=52–04–03.5 tan 0.10825 sin 9.89694

z= 9–18–02.5 tan 9.21423 sin 9.20848

B=44–10–42 tan 9.98755 cosec 0.15683 cos 9.85562 sin 9.84317

C=30–04–00 cos 9.93724 cos 9.03724 sin 9.69984 cos 9.93724

$\cos A \cos B \cos C$ = + .18353

$\sin A \sin C$ = ± .47860

log 9.20372 log 9.67997

Lat. = 41–27–43 # N. $\sin$ + .66213

t= 53–35–33 sec 0.12529

T=100–39–48 sin 9.90570

Long. = 47–04–15 #

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE TRANSPORTATION SYSTEM OF A NAVY YARD.

By R. E. BAKENHUS, Civil Engineer, U. S. Navy.

Transportation is admittedly an important and complicated navy-yard problem. By providing superfluity of equipment it becomes simple enough, but under such conditions is a source of greatest waste. To improve efficiency general schemes and routes may be worked out to advantage, but the problem is so variegated and ever-changing that no such general schemes and routes can possibly meet all the needs.

In attempting to accomplish efficient transportation it must be borne in mind that the transportation system is an aid to the shops and ships. In reducing haulage costs care must be taken not to curtail facilities to such a point as to reduce efficiency of the industrial or military establishment. As a matter of fact, the aim should be maximum efficiency for the whole establishment, which may be had even though each individual part, be it a shop or a transportation system, does not have an individual lowest cost. This principle may be otherwise stated thus: The maximum efficiency for any branch is that which brings about the maximum efficiency of the whole.

The transportation facilities of a navy yard may be listed as below:

(a) Horses and wagons.
(b) Motor trucks.
(c) Steam locomotives for standard-gage railroad.
(d) Freight cars, dump cars and miscellaneous flat cars for standard-gage railroad track.
(e) Locomotive cranes.
(f) Hand or push carts.
(g) Timber wheels.

(h) Roads, railroad tracks, approach ways to buildings, loading and unloading platforms, etc., naturally form a very important part of the transportation system of the yard.

The transportation problems of the yard embrace the following—the sizes of loads vary from heavily loaded freight cars or drays to small, light packages:

(a) Delivery of stores from the general storehouses to the shops and other points of consumption.

(b) The supplying of ships with various stores from the storehouses.

(c) The transfer of manufactured articles from the shops to the storehouses.

(d) The transfer of manufactured articles or articles in process of manufacture from one shop to another or from shops to ships.

(e) The collection and disposal of refuse in the yard.

(f) The handling of materials in connection with construction work of the public works department.

(g) The movement of freight cars delivered to the yard by the railroad company and return of empty or loaded cars to the railroad.

(h) Transportaion of coal from the coaling plant to the power house or from the coaling plant to various minor points of consumption.

(i) Miscellaneous.

To perform this work the equipment listed above is available. Hand carts should not be used when teams can do the work better, and *vice versa;* nor should a double team be used when a single team can do the work. There are instances where materials should be moved by car and not by wagon. Certain materials can be handled on routine deliveries; certain other materials require urgent or special delivery.

The amount of work which a vehicle can do and its general efficiency depend on the following factors, which may be called the efficiency factors:

1st. *Time of Getting into Position for Loading or Unloading.*

(1-a) The time required to pull up to the loading point after arrival at building includes backing up inclined approach ways and into doorways, turning teams, etc.

(1-b) The character and arrangement of the vehicle as to access for loading, whether from end or from side, considered in connection with the loading platforms and other local conditions.

(1-c) The facility with which the vehicle can be backed or turned. (Compare electric vehicle with two-horse team.)

(1-d) The character of the approach to the building and size of opening.

2d. *Time of Loading and Unloading.*

(2-a) The time spent waiting for load after vehicle is in position.

(2-b) The time actually spent in placing goods on the wagons.

(2-c) The loading and unloading facilities at points of regular calls: platforms, elevators, etc.

3d. *Time under Way. Speed.*

(3-a) Motive power of vehicle, whether horse, electric, gasoline engine, locomotive or hand.

(3-b) Condition of roads or tracks as to state of repair.

(3-c) Condition of roads or tracks as to cleanliness, especially as to freedom from ice and snow in the winter time.

(3-d) Delays while under way due to other traffic or to accidents and breakdowns.

(3-e) State of repair of the vehicle.

(3-f) Condition of horses or mechanical power.

(3-g) Average travel of draft horses usually not over 15 miles per day at the rate of about 3.5 miles per hour, giving actual average maximum travel time of 4½ hours and necessary rest of 3½ hours.

(3-h) Average travel of electric vehicles has been found to be 35 miles per day in actual commercial service at a rate of 6.5 miles per hour. The full daily mileage may be made in 5½ hours, allowing 2½ hours standing time for loading.

(3-i) It is evidently more important to load electric trucks rapidly than horse vehicles.

(3-k) Length of average haul, if short, is bound to reduce the "time under way."

(3-l) Vehicles traveling empty on return trip or covering unnecessary distances reduce the average efficiency.

4th. *Size of Loads.*

(4-a) The greater the load, within limit of capacity of the vehicle, the greater the efficiency and the ton-miles per vehicle.

(4-b) Vehicles should be assigned carefully, light vehicles for light loads, large vehicles for heavy loads, etc.

5th. *Routing of Freight.*

(5-a) Divide into three classes: 1st, freight which may be handled on regular routes; 2d, miscellaneous freight requiring special routing; 3d, emergency calls requiring unusually prompt delivery.

(5-b) Routing of all freight by one central authority.

(5-c) Routing to be such as to utilize equipment in the most efficient manner and at the same time serve the various interests efficiently.

6th. *Equipment.*

(6-a) Equipment should be selected with special reference to the class of merchandise and average-sized loads.

(6-b) Equipment should be kept in good working condition, with all axles and bearings well oiled and machinery in efficient state.

(6-c) The appearance of equipment should be kept up to a high standard, for its general effect on the personnel and as an evidence of an efficient administration.

(6-d) Regular and continual inspection of all rolling stock followed up by prompt repairs.

(6-e) Hostling of locomotives and locomotive cranes during night hours, including regular light overhauling and firing and watering, so as to have them in readiness at the beginning of working hours.

7th. *Personnel.*

(7-a) The various drivers should be carefully selected with a view to their duties. They should be subject to a constant course of instruction in connection with these duties.

(7-b) A feeling of loyalty and desire to do efficient work should be developed in the personnel, the same as in all other branches in navy-yard work.

The general principles affecting a transportation system having been stated, it remains to suggest the steps whereby any existing service may be improved. A study in detail of the present performance of the vehicles must precede all else. Note the time taken under each of the subdivisions in the list given above. Delays and their causes should be noted for each vehicle, and data collected showing the mileage for each vehicle or team of horses and the cost of the various forms of transportation. A great help in this connection would be a recording odometer, showing for each minute of the day whether the vehicle was standing still or moving, and the rate of speed. It would not be surprizing to find that a motor truck which is capable of 35 miles a day is making only 6.5 miles, or that a team which is capable of 15 miles a day is making not over three.

Observe the size of the loads and determine the ton-miles for the various vehicles and the distance traveled empty.

A detailed study should also be made of the loading and unloading facilities of approaches to buildings, and the physical condition of roads and tracks. Minor extensions of the railroad track system may in many cases greatly facilitate transportation.

The following are definite steps that may be taken:

1. Establish regular routes for freight-handling touching all points where freight is frequently received or issued.
2. In each storehouse and shop establish regular points for the receipt and discharge of freight. A loading and unloading platform should be built and all freight stored on the same, if possible, before the arrival of the team.
3. Require all freight to be ready immediately before arrival of the wagon and do not allow it to wait for freight not ready.
4. Improve the approaches to the loading and unloading points, so as to reduce the delay in getting to the loading point.
5. Assign definite vehicles for the freight routes, the vehicles to be especially fitted for loading and unloading the regular freight at the platforms. Platforms in all shops, storehouses, etc., to be alike and fit the vehicles.
6. The freight trucks should not be assigned to any one department, and should handle freight regardless of whether it belongs to one department or another. The trucks

should be available for taking manufactured articles from one shop to another, as well as for delivery of general stores.

7. Establish a special delivery team for urgent work, to be kept ready for instant service near the office of the transportation foreman.
8. All drivers, locomotive tenders, crane operators, etc., to keep in close touch with the transportation foreman by a telephone at stated periods, and to report when assigned work is completed.
9. Installation of recorders on all important vehicles to indicate delays and movement. Only by keeping a continual record of the performance of each important vehicle can the efficiency be kept up.
10. Provide proper equipment. The decision as between horse, electric and gasoline vehicles cannot be made off-hand, but should be made only after a detailed study of average loads, distance of hauls, time consumed, and cost per ton-mile, combined with general efficiency of the service.
11. Careful and economical feeding of horses. They may be fed from an overhead feeding floor directly into the manger, and the portion for each horse accurately weighed.
12. Maintenance of roads and tracks in good condition to prevent accidents, and to reduce wear and tear on equipment, and cost of hauling.
13. Regular periods of overhaul and careful charging of electric-motor vehicles.
14. Continuous and systematic inspection and overhaul of all rolling stock.

An efficient transportation system requires at its head someone with training and experience in this line to keep in immediate touch with the changing situation, to know what facilities are available at a given moment and to decide instantly what form of transportation to use, as well as to maintain the general routes in operation; also to know in detail the general character of freight to be moved, to keep in touch with work in progress and to know in advance the probable demand of the various shops or ships.

An interesting example of how problems in transportation may be handled is observable on the Panama Canal work. The movement of all construction trains, dirt trains, steam shovels, and

workmen's noon-hour trains, together with special runs of locomotives—such as transfer of injured men to hospital, etc.—is handled in the Culebra cut by a despatcher and his assistants posted in a tower with adequate telephone and signal apparatus. Remarkable efficiency results from this system. A general plan had been laid out, but it was continually necessary to modify it to meet special conditions as they arose, and only the instantaneous decisions in handling the special cases prevented the whole from getting into an inextricable mass.

Much could be gained by the establishment of a transportation shop with a foreman of transportation in charge, reporting to the proper officer. All the rolling stock, including locomotives, cars, wagons, trucks, motor vehicles, push carts and locomotive cranes, should be placed in the transportation shop and be assigned for use and be controlled by the transportation shop.

Inasmuch as the transportation system should not be operated in the interests of any one department or division of the navy yard, it is not considered that any of the vehicles should be marked with the name of any division or department, but should bear the designation "Navy Yard," with the number of the vehicle. For instance, hand carts are at times marked with the name of a particular shop or division; also, trucks are marked with the name of the department that provides them. This, it is believed, does not foster the proper spirit, which is that of loyalty to the navy yard as a whole, and not to any one department or shop.

It is realized that the problems herein brought up are not all easy of solution. Willing coöperation of the various interests concerned is essential.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SAVING MONEY FOR THE NAVY.

By Asst. Naval Constructor C. A. Harrington, U. S. Navy.

For many reasons it is with a feeling of timidity that the task of writing down ways and means for effecting economy at navy yards is approached. Much has been written and more has been spoken during the past three or four years on this topic than upon any other naval subject, and much that has been spoken and written has been, it must be regretted, either highly colored or discolored. The field is a large one and the problems found therein are so important that their solution should not be affected by prejudice or personal feeling. If such factors enter into the solution of our problems, the solution is apt to be an incorrect one. If such be the case, it is important to note that the losing parties are, first, the navy, and second, the people who support the navy. The saving of money at navy yards, or, in other words, the efficient expenditure of navy yard appropriations, is going to be a more serious question in the future than it has been in the past, and the navy should be always in a position to merit and maintain the confidence of the people. This confidence of the people, expressed through their representatives, has not been as positive as it should have been in the immediate past, and the reason for this lack of confidence has been nothing more nor less than our navy yards. We must look this condition straight in the eye and admit it as a fact.

There are undoubtedly a large number of us who think that we are sailing along now under the very best conditions that can obtain for efficiency in navy yards, when the efficiency of the service as a whole is considered. The situation in respect to our navy yards to-day, however, is much the same as the situation which existed in respect to gunnery and target practice in 1902 and 1903, when Captain Sims started his revolution which has

produced such marvelous results. The time is not so very far distant in the past when our ships went out to sea and fired at rocks and other poor targets, and everybody was glad when all the ammunition had been dumped into the sea. Do you not remember the feeble protests made by those who, for one reason or another, did not fancy the methods of Captain Sims? The march of efficiency in gunnery went straight on, however, despite the feeble protests of the opponents, and in just the same way will efficiency proceed in our navy yards. A few there may be who will block the procession for a while, but ultimately they will either join in the procession or be trampled under foot. Such has always been the fate of those who interfere with true progress.

"The best is none too good" for the navy is a principle that we of the navy should at all times insist upon, and no work should be too difficult nor any effort too great to prevent us from attempting to get the best. We should bear in mind that economy measured in dollars and cents is the same kind of economy which may be measured also in the saving of time. The saving of time at navy yards in periods of war will be true economy for the nation. Broadly speaking, we would expect the most economical yard in time of peace to be the yard most expeditious in war time in repairing our crippled ships. In other words, in order to be efficient at a critical period our navy yards must surely first be efficient in less troublous times.

In making an investigation of the efficiency of any piece of machinery in the mechanical world, electric motor, steam engine, etc., one must first analyze the component parts of the machine in order that he may formulate plans for the running of the efficiency test. In much the same way, in analyzing navy yards, the careful investigator first studies the

ORGANIZATION AND MANAGEMENT.

Navy yards are established solely for military purposes and their function is to repair ships and put them in readiness to join the fleet, both in peace and in war time, in the shortest possible period. The means which are employed to secure these ends are entirely industrial, consisting of tools or machines we may say, such as machine shops, smith shops, joiner shops, foundries, power plants, etc. It seems axiomatic, therefore, that to attain

the object for which yards are established we should have the best men in the navy in charge, who are familiar with the tools at their disposal, whether these men be civil engineers, naval constructors, paymasters, or line officers. In subordinate positions we should have the best officers that can be obtained, who have a liking for the work that they are to do. Detailing a man for work at a navy yard simply because of his rank or because he is due for shore duty is harmful to the man and demoralizing to the yard. This is one of the vital defects of our present organization, namely, that it does not bring to light the inefficiencies of officers holding subordinate positions.

Having fixed the qualifications for the management, it may be properly asked how we are going to secure the man for the job of manager. In the absence of other means there is none better than the time-honored custom of putting the applicants through an examination, and making the examination as thorough and searching as possible. It is beyond the scope of this paper to go into such details as the examining board and other features involved. It should be observed that this plan is really a slight variation of "promotion by selection," with the undesirable features of this policy eliminated.

Relative to organization, it may be said that an industrial enterprise must necessarily have an industrial organization. It is here that our present navy yard organization falls down, in that we have a military organization to perform industrial work. What is needed is an industrial organization managed by military men, and by military men is meant the paymaster, naval constructor, or officer of the line, as the case may be. Such an arrangement will give us an opportunity to apply functional management to navy yards, the result of which will be a wonderful saving in time and money, which is the prime consideration in a successful plant.

This feature may be illustrated by a typical concrete case. A ship is due to sail from a navy yard on a certain day, but as it seems to the commanding officer of the ship that repairs to his vessel will not be completed on the date set, he journeys to the commandant's office and expresses his fear on that score. As the commandant is not sufficiently cognizant of the details of the delayed work, on account of a multitudinous number of other details which he is supposed to handle, he naturally calls up on

the telephone the division or divisions concerned. The delayed work involves the machinery division on the surface so the commandant calls up the head of this division. The engineer officer is not able to give as exact information regarding the job as he would like, because he has not seen the work in question since morning, so he tells the commandant that he will let him know in a short while—as soon as he can get hold of the subordinate who is running the job and get the details from him. In this manner the engineer officer finds out that the completion of his work depends upon the time it will take the hull division to finish its part, say the drilling of certain bulkheads, and he so reports to the commandant. The commandant now calls up the construction officer, but this official cannot tell exactly, as, like the engineer officer, he has probably not seen the work since morning, and must consult his subordinate who is on the job. After going over the details with the subordinate, he makes his report to the commandant. Thus, after considerable backing and filling, the commanding officer is assured that the work on his ship will be finished on time. This assurance is not given as a result of a military order issued by the commandant; it is given only after careful consideration of certain industrial problems—the time it will take to drill a certain number of holes in half-inch plate, sheathe a certain area with galvanized sheet steel, run a certain number of feet of steam or cold-air piping. The above case is not a hypothetical one by any means, but probably one of the simplest and most frequent that arise in navy yard work. Can anyone imagine for one moment that a private business could employ such methods and pay the dividends which stockholders insist upon getting? Does anyone think that a system which would eliminate so much duplication and lost motion would in any way impair the military efficiency of the yard? These questions can be answered correctly only in the negative.

The logical query now is regarding the details of the proposed system. The answer, broadly speaking, is, first, consolidation, immediately followed by the establishment of functional duties for all officers, these duties to be described as minutely as possible, so that responsibility may be definitely fixed. By consolidation is meant having one manufacturing department instead of two, as at present. It is illogical to have half the shops of a yard under one management and half under another management. The

machines or tools which we are to place at the disposal of our qualified manager must necessarily be in one group, under one responsible subordinate, whose function would be shop management, and who would have a uniform policy and system prevailing in all shops. We now provide the manager with two groups of subordinates, and the organization is completed. The functions of these are as follows: the first group provides and feeds work to the tools or machines; the second group sees that the tools or machines execute the work in the most efficient manner. In the first group we would have the designers or planners of hull, ordnance, electrical and steam machinery, the general storekeeper, and the purchasing pay officer. In the second group we would have the several outside superintendents in charge of work on board ships, the shop superintendent, and the accounting officer. The duties of these positions could be divided among the commissioned and warrant officers assigned to a yard, so that the function of each and the responsibility attached thereto would be very clearly defined. We thus have every officer of importance directly responsible to the manager, instead of the semi-quasi responsibility of a subordinate to the commandant through an intermediary head of division as at present. The result would be increased efficiency with consequent economy of time and money, because we would not have two divisions working, as they continually are at present, without any connecting link, and working frequently at cross-purposes.

Under the scheme which has been outlined the commanding officer of a vessel would go to the manager and interview him as to the chances of his repairs being completed on time. If the manager were not conversant offhand with the details he would simply call on his assistants who had direct charge of the job and the matter would be settled in short order.

It is well to emphasize here a consolidation which would result in a yearly saving of at least $10,000, namely, the placing of the purchasing officer under the manager of the industrial yard. The purchasing pay officer, a sort of free lance under present conditions, is always located in private offices, the rent for which is paid by the government, in the city where the yard is located. Is this good business policy when very good offices could be fitted at the yard itself and the government saved rent paying and other expenses? No argument can be found for locating the purchasing

pay office outside navy yard limits, unless it be the desire to have it convenient to possible bidders. This argument falls down, however, on account of the fact that the business of the pay office, due to the navy system of purchasing, is what might be called a mail-order business; in addition, the standard samples which are referred to in many specifications are always kept in the office of the general storekeeper! If we think of the number of papers that pass between the various offices in the yard and the office of the purchasing officer, and vice versa, we can only wonder that the purchasing office has been allowed to remain aloof so long. The reason may be that it is one of those good old expensive customs of the service which we hate to change.

It is unnecessary to go into further detail in regard to management and organization. The subject would not be touched upon at all were it not for the fact that efficiency at navy yards will never reach a high point until the management and organization are the best. In getting the best industrial management, we do not in any way interfere with the military efficiency of the yards, or, most important, the military efficiency of the fleet. On the contrary, military efficiency is increased.

Next in importance to efficient management in the saving of money for our navy yards is

AN EFFICIENT PLANNING SYSTEM.

An efficient planning system will generally be found as an adjunct of an efficient management, as the two go hand in hand. In a broad sense, successful factories and industrial plants have always had a planning system of some sort in use; if this were not so chaotic conditions would result. The important question to-day is the extent to which planning should be carried.

The object of efficient planning is to secure the greatest possible economy of time in the execution of any job assigned to a yard, and hence to perform the work at the lowest possible cost, at the same time maintaining the highest necessary standard of quality. To attain this end it is important to note that, though a general system may be outlined for all our navy yards, the detailed or the particular system for each yard depends on local conditions. In a word, each yard is a problem by itself, and the best system for it can be arrived at only by a process of trial and error, great

caution being exercised to make as few errors as possible and to correct the errors in the shortest time. It will, therefore, be apparent that the installation of any system calls for the exercise of the utmost vigilance on the part of those in charge, so that they may detect and correct any false steps.

The means necessary for the detection of errors in the system must be provided by the general system for all yards, and these means are no other than the providing of certain accurate records of details and costs. If the general system does not provide these means, it is safe to say that it will not be possible to install an efficient system, and the general system should accordingly be changed and a fresh start made. The system should certainly provide the means to determine whether or not the object of the system is being attained.

The complaint against many planning systems in private concerns is that the mechanic is displaced by a clerk, and that too much clerical and paper work is involved. The reason for this complaint is that clerks are generally regarded as non-producers and their number must be kept as low as possible, as clerical work is generally charged in the overhead expense of a private plant, and a big "overhead" is looked at with alarm. At a navy yard clerical salaries do not charge on the work as "overhead," but to an appropriation instead, and it has also been found feasible under the present accounting instructions to charge the pay of improvised clerks and certain supervisors employed in planning to appropriations rather than to the overhead or indirect expense. It will be seen, therefore, that planning at a navy yard may be executed in greater detail than the average private plant will tolerate, for the simple reason that the planning force is provided gratis, so to speak. This, of course, is distinctly wrong and the wages of clerks and supervisors should be included in the indirect expense, else the tendency will be to maintain an expensive planning staff under false pretenses. The meaning of this is made clear when we understand that planning in detail tends to reduce the direct labor cost and to increase the indirect labor cost. If we maintain a system which shows on paper a decreased direct labor cost of production and takes no account of the means by which this decrease is effected, we are simply practising self-deception. It is a very attractive proposition to be able to show a decrease in direct labor cost due to the installation

of a system, but the cost of the system should be included, otherwise we shall have no accurate means of judging the extent of detail planning the business will profitably stand. To determine this two things are necessary: first, to make accurate charges for everyone connected with the planning; second, to observe the effect of the planning on the cost of production. For this purpose it will be best to observe the cost of production of a number of standard articles, the cost of which prior to the establishment of the system is available. It will be found that detail planning at first causes the direct labor cost to decrease and the "indirect" to increase, with a resultant decrease in the total cost. As the details of planning are further extended the direct labor cost will further decrease and the indirect increase. A point will be reached when the increase in the "indirect" more than offsets the decrease in the direct cost, with the result that the total unit cost of our standard article produced under a detailed planning system is more than the cost of the same article produced without the system. If the observation of cost variation has been intelligently made the conclusion must evidently be that, for the volume of business being transacted, we have reached the safe limit of our detailed planning. I have called this the safe limit, because it is arrived at by a consideration of the only means at our disposal. It should be borne in mind that planning shows the least economies on these standard manufactured articles which are frequently repeated, thereby affording the means for the comparison above outlined. No two repair jobs are exactly alike, and hence the field for comparison of costs on this class of work is somewhat limited, in that the character of the work does not permit of accurate comparison. Certain repair and overhauling jobs more or less similar have been done, however, both with and without a planning system. The result has been that the work performed under a planning system has in all cases been materially less costly, which leads the author to conclude that detailed planning which barely sustains itself, judged on the basis of returned costs of manufacture work, is actually effecting great economies in repair and overhauling work on ships. Hence the use of the expression "safe limit."

The ultimate test of any planning system is the results which are secured from its operation. If the system be an efficient one signs of efficiency are immediately visible in the moral effect

on the working force, because, if the management be sincere, each man knows that he is going to get more of a square deal than he has been getting. There will doubtless be some signs of unrest among the working force, but this restlessness is caused by the shirks and inefficient men who have been carried along by antiquated methods and who naturally fear exposure under the reign of efficiency. Planning naturally results in specialization, in that each man is given to a greater degree the work for which he is especially adapted. A good planning system relieves the officers in charge of a number of details so that their time may be spent on the bigger problems, the solution of which is much deferred if an officer be bound to a desk by petty details. At the same time the good system furnishes him a ready means whereby he can at any time become instantly familiar with the work under his charge.

It is impossible to estimate the saving that can be effected by the installation of an efficient planning system at navy yards. Much has been claimed for efficiency methods, both as to what they have done and what they will do. It has been estimated that efficiency methods will save the railroads of this country $1,000,000 per day; there are some who think that sufficient saving can be effected in navy yards in one year to construct a battleship. These of course are mere guesses. More reliable results are obtainable from the system which has been in effect at the Watertown arsenal for the past few years, which results would seem to be convincing to the conscientious seeker after truth. The latest reports from this plant indicate a great saving in the cost of the ordnance manufactures, which saving has been accompanied by an increase in wages for the working force.

In concluding these remarks on the efficiency of a planning system, it is interesting to note the resemblance of an efficient planning system to the use of labor-saving machinery. Its introduction may be opposed by the skilled mechanic who imagines that the increase in efficiency is to be obtained by doubly increased effort on his part. He probably has in mind that point of the efficiency curve where it begins to flatten out, and where considerable effort is required to produce even a slight increase in efficiency. To avoid this impression we should look at efficiency in what we may term a negative way, namely, as the elimination of waste or the limiting of waste to the smallest possible factor.

If therefore there is any truth whatever in the statement that navy yards are wasting each year an amount of effort measured in dollars and cents which is equivalent to the construction of a first-class ship of the line, it means either that our system is not working efficiently or that the system itself is not efficient. Such conditions can be relieved by the insistence upon our principle that, for the navy, "the best is none too good."

NAVY YARD MANUFACTURING.

The principal function of a navy yard being the overhaul and repair of ships, the possibility of utilizing the plants made necessary for this purpose as manufacturing centers of fleet supplies has been in great measure overlooked. In past years navy yards have manufactured only such articles as the bureau involved did not purchase in the open market, either because the article was of such type as not to be procurable in the open market, or because private contractors demanded distinctly exorbitant prices for such supplies. During recent years the practice has been to depend more on navy yards for the manufacture of fleet supplies. It is hoped that this essay will point out the economy resulting from the very great extension of this policy, it being the belief of the author that, by so doing, large sums may be annually saved to the naval appropriations. The question will bear very careful analysis.

Let us assume, for instance, that brass hose nozzles, according to certain specifications, have been purchased from private contractors for $2.50 each and the lowest estimate received for navy yard manufacture is $2.40 each. The navy yard estimate means, according to our system of accounting, that is, by not counting in the cost of insurance, depreciation, taxes, salaries of officers and clerks, advertising, and a few other things, that the navy yard is able to underbid the private contractor and is awarded the work. Again, let us assume that the navy wishes to purchase some ash oars. A private contractor, who incidentally has practically a monopoly of the ash oar business, bids $1.50 per oar; the navy yard cannot make it cheaper than $1.75 on the basis of our present accounting, and loses the business. Where does the deciding bureau draw the line? The navy hose nozzle, though nominally cheaper than the purchased one, is actually higher priced if a fair

comparison of costs be made. As a matter of fact, it is more economical to manufacture both articles at a navy yard, which will be shown by the following consideration.

The United States government has equipped and maintains complete manufacturing establishments at Portsmouth, Boston, New York, Philadelphia, and Norfolk on the Atlantic coast; Mare Island and Puget Sound on the Pacific, and Cavite in the Philippines. The mere maintenance of these plants calls for the outlay of considerable sums of money, whether a large or a small amount of work be performed. The shop which would make the ash oar for $1.75 has to be heated, lighted, kept clean, etc., whether the oar is made there or somewhere "far from the busy haunts of man, where labor is content," at the rate of ten or twelve hours per day. The cost of this maintenance would prorate about 30c on the ash oar. Note carefully that the bureau in effect says, "No, we will not allow the navy yard to manufacture the oar at $1.75, but we will pay $1.50 to the outside contractor and spend the 30c to keep the yard going, or a practical total of $1.80 for the oar." In other words, although the actual expenditure at the navy yard for direct labor and material is $1.45 per oar, the bureau allows the work to go to a private concern, thus wasting 5c per oar. The shop which would manufacture these oars has the same total amount of overhead expense, whether the oars are made there or not. If the oars are not made in the shop the total overhead expense is proportioned on a less volume of work, with the consequent result that the cost of this other work is made higher. The bureau involved does not even effect a saving in its own appropriation by the short-sighted policy.

Anybody knows that, up to the capacity of a plant, the more work that is done the cheaper it can be done. This is nothing more than an application of the law of increasing returns. In slack times at navy yards the cost of work is generally higher on account of the higher percentage of indirect expense. In busy times the reverse is true. As a matter of fact, by manufacturing ash oars at a very busy time the indirect expense would be so low as to make the total cost of the navy yard oar less than the cost of the purchased oar. From the foregoing, it will be seen that in navy yards the indirect item of cost establishes fictitious values which are not comparable with commercial values.

If we assume that the cost of an article manufactured at a navy yard is comparable with the purchase price of the article from private contractors, it is apparent to the careful investigator that many articles which are purchased for naval supplies could, with advantage, be made at navy yards. There are many reasons why navy yards are thus able to underbid outside contractors. Although supplies are purchased as a result of competitive bidding, at times there is competition in name only. For example, practically all the hardware for the navy is furnished by one concern, most hardware firms shunning navy business; manufacturing firms which furnish supplies to the navy equip themselves with special appliances which give them such advantage over competitors that they are able to secure contracts year after year at good prices; articles are frequently purchased on specifications which prescribe that articles must be similar to the sample in the custody of the general storekeeper at the New York yard, which limits the bidding to firms in the vicinity of New York. Many articles which fall under the foregoing classifications can be manufactured more cheaply at navy yards than they can be purchased. Perhaps the most glaring instance of this sort which was discovered by the writer was a wooden toggle purchased for 54c, the cost of which, if manufactured at a navy yard, is estimated at 4c. A careful investigation of such cases by a competent officer would save the government at least his salary many times over, and would provide yards with much more manufacture work, the advantages of which are hereafter stated.

In many cases navy yards are unable to compete with private firms if the total cost of the navy yard article is considered. If, however, the navy yard be favored in the comparison of costs by not considering the indirect cost, there is at once a very great additional amount of manufacture work that can be awarded to navy yards. There should be no objection to this policy, because the governing factor in the comparison of navy yard costs with outside costs should be whether the sum of the direct labor and material of the navy yard article is more or less than the purchase price of the same article. Let us remember that the law of increasing returns applies to a navy yard in just the same way that it applies to a railroad or other public utility.

The practice of awarding manufacture work to navy yards on the basis of competitive bids has already been inaugurated. The

foregoing arguments are to be considered as a plea for the rapid extension of the system. Some of the advantages of this policy are as follows: Saving of government funds which will easily amount to many thousand dollars annually; navy yards will be furnished with more work; it will be easier to maintain a stable working force, and the yards will operate at greater efficiency, as they will be working closer to their capacity; the quality of the supplies will be better, the manufacture being carried on by government officers (purchased articles are frequently found to be made of cheaper materials than specified); improvements in design are more likely to result.

The small amount of manufacture work that is being done in navy yards at present has been distributed as a result largely of competitive bids. This practice is a very good one and has already resulted in great economies. A better plan would seem to be the concentration of the manufacture of practically all equipage supplies, both titles B and Y, at one navy yard, preferably a small one which has not much ship work. At such a yard, by the application of piece work and bonus systems, it is impossible to say how much could be saved to the naval appropriations. Concentration of manufacture work at one manufacturing yard would, it is believed, be more efficient than the present method of distribution, because by concentration we reap the benefit of consolidation and specialization.

CARE OF SECOND-HAND OR SALVAGE MATERIAL.

Navy yards are the depository for a wealth of valuable articles which we may designate as second-hand material. This material is continally accumulating. A ship's steamer is condemned by survey at a yard and is recommended for sale. Before selling, the metal fittings, consisting of cleats, chocks, pads, etc., are removed and more than likely are thrown in some corner of the boat shop, and they may be used again or they may not. The amount of second-hand material now at yards is probably larger than ever before, due to the extensive overhauling and removal of top hamper from our ships during the past three years. To thoroughly appreciate the volume of this material and its value it is necessary for one to be intimately acquainted with every nook and corner of a yard. There is at present no good systematic method for taking care of this material and, as a result, much

money is wasted in making new parts for repair work when some second-hand article on hand would do just as well. A large part of this material can of course be turned into store and taken up by survey at an appraised value. Cleats, chocks, hangers, etc., from our condemned steamer, block straps and hooks from condemned blocks, etc., can be easily turned into store and made available for re-issue when required. Such practice, which could be made automatic, cannot be recommended too highly for such articles for which there is a constant and steady demand and which are kept in store in large quantities.

Most of our second-hand material is, however, of a different character. It consists of hatches, hatch combings, skylights, pad eyes of various sizes and shapes, topmasts, booms, crow's-nests, ladders, hammock boxes, boat davits, etc., for which there may be a demand to-day and for which there may not be a demand in five or ten years. The writer has seen many of such articles which reposed in a navy yard for years finally worked in on the repairs to collier, gunboat, auxiliary, and battleship, with consequent saving of very much time and money to the government. We can afford to keep such material for years in the hope of using it sometime.

The question is, how shall such articles be stored and kept so as to insure their being used when opportunity offers? It does not seem proper to turn them into store, because, on account of the uncertain demand, they might stay there too long. No general storekeeper wants to have his storehouses filled with such inactive material and have the money of the naval supply general account of advances tied up in such a manner. Then, too, if such material is turned into store there is not the same disposition on the part of the manufacturing department to use it. Such material should be continually under the eye of the outside superintendent, the planning division, and the draughting room. Only those who have had the experience know the gratifying feeling that the outside superintendent has when, for instance, the overhaul of a certain vessel calls for, say, the installation of a hatch and a skylight, and he knows that they can be produced on the ship in half an hour with no cost to the government. Much can be done with paint and varnish so that in a short while our old material looks like new. It is just as strong as new material, the ship's inspectors are satisfied, and the cost of a brand new hatch and

skylight is saved. Experience and economy demand that salvage material of this character be stored in an orderly manner, listed, if necessary, in a building under cognizance of the manufacturing department, where the same may be easily accessible to the draughting and planning offices.

CARE OF SCRAP.

Navy yard scrap of all kinds was formerly a source of great waste and loss on account of the methods that were employed in caring for this sort of material. A considerable saving has been made in this line by the recent systemization of methods, although the wood scrap from joiner and other wood-working shops is still wasted in at least one yard and probably in all. In connection with the saving of scrap, it may be said that the nucleus of the present method, installed by a civilian expert during the past year, was suggested by a government officer to the commandant of a certain yard in a written recommendation for the care of scrap three years ago. For some reason the recommendation was never acted upon. It is not, however, necessary for a civilian "expert" to be engaged to tell department heads what they probably know already. If any Navy Yard official of discernment glance at the weekly quotations for "old material" in the Iron Age, the different prices which are paid for different classes of scrap will show him how to classify and segregate his scrap so that the maximum amount will be obtained for it each year at public sale.

TRANSPORTATION.

The transportation facilities of a yard should be carefully studied, including crane tracks, railroad tracks, delivery wagons, etc., so as to secure the minimum amount of handling material and to get the material to the place where it is required in the shortest time. Laborers are probably the least intelligent class of men employed in navy yards and are more prone to "soldier," so that on this account improvement in transportation facilities will tend to overcome the shortcomings of laborers who must be used in handling material, and thereby produce economies. If a delivery wagon is not employed in a yard it will be seen, from an inspection of the returned cost of job orders, that nearly every job bears a transportation charge, and it is usually a poor

job that cannot stand at least $2 for transportation. The reason for these excessive charges need not be given, but we may instead state the remedy, which consists in the employment of a wagon making regular rounds between ships and shops. This wagon can make in some yards four complete trips a day, and can also be used for messenger service. Its use will be found to very materially decrease the cost of handling material. By its use also we are able to discourage a skilled mechanic and his helper from taking a long walk from the shop to the ship and vice versa with a small piece of pipe or other material on their shoulders. We also relegate the push-cart to the scrap heap.

In a certain yard the tracks for a 50-ton crane fell some 75 feet short of serving a ship lying at the pier. The ship was in ordinary undergoing considerable overhauling and the crane was alongside the ship practically for six months in continuous operation. Owing to the fact that the tracks did not permit the crane serving the ship along her entire length, it was necessary to warp the vessel end for end rather frequently, which required the assistance of one or two private tugs and interfered seriously with the progress of work, as the ship could not be warped each time outside of working hours. A large number of men were employed on board and, as their work was frequently interrupted by the necessity of breaking air connections, it will be seen that the money loss to the yard was a severe one.

The present control of transportation in navy yards, namely by the captain of the yard, is illogical inasmuch as it is a step toward decentralization. It should of course be under the qualified manager.

PURCHASE AND RE-ARRANGEMENT OF MACHINERY; IMPROVEMENTS IN PLANT.

In times past much money has been absolutely wasted on machinery. There are perhaps in all yards costly machines which have never been used, and some that have not even been set up in position. The tendency to-day is more toward the re-arrangement of machinery with the idea of so-called consolidation. New machines should not be purchased nor old machines re-arranged unless the outlay will net at least a fair return on the investment. The cost of a prospective machine is always available, and the

estimated cost of installation will give us an exact idea of the entire cost. The saving in labor that the machine will cause can in many cases be closely estimated, because the machine is or should be bought with a specific object in view. If with these figures at hand it cannot be shown that the machine will pay at least ten per cent on the investment in addition to paying for its depreciation, its purchase should not be considered unless there are other points in its favor. Similar procedure should govern in determining whether or not machinery shall be re-arranged. The matter should be looked at from a business standpoint, and not with the idea that there is on tap in Washington an amount of money which can be secured simply on request.

CARE OF STORES.

Frequently large sums of money are lost owing to the deterioration or inactivity of certain stores. Every once in a while the general storekeeper at a navy yard calls a survey on this material and, frequently as a result of the survey, the material is sold at a ridiculous price. A survey is often a visible sign of waste. There should be practically no necessity these days for stores becoming inactive if there is co-operation between the manufacturing department and the general storekeeper, which co-operation would be greatly increased by the establishment of one manufacturing department, and if the double bin system of caring for stores were used. This method insures the use of material in the order of its receipt in store. Its adoption for navy yards would result in perhaps a slightly increased amount of storage room, which would be more than compensated for by the resultant saving, especially when it is considered that all navy yards have an excess of space devoted to the storage of material.

HEALTH AND COMFORT OF THE WORKING FORCE.

These days it is the desire of the department to make the enlisted force on board ship comfortable in every way, so that the fleet may be a fleet of "happy ships." In the same way it should be the aim of the yard management to do all in its power to make the working force content, because by doing so better results can be secured. To keep the force in good condition during working hours and produce efficient results, shops should

be well lighted, well ventilated, heated, and kept clean. The spread of disease should be guarded against by the use of antiseptic drinking fountains, which should be made compulsory in all government shops immediately. This has already been done in a great many cases by energetic shop managers in our yards. War should be waged against the practice of expectoration, which is only too prevalent in many shops. The beneficial results of such treatment will be immeasurable.

All government shops should be fitted with sanitary wash-rooms and toilets, and, if possible, attractive places set apart for the men to eat their dinners at noon and smoke afterwards. In a word, Navy Yards offer the best field of any industrial institutions for the promotion of welfare work, due to the absence of the foreign labor element. These days an up-to-date manager prefers to have a neat flower garden outside his blacksmith shop than a pile of scrap iron because he knows that it pays. A machine shop surrounded by green grass is a better paying proposition than one surrounded by cinders and gravel. It is now realized that the features mentioned in this paragraph have an actual money value visible in increased production.

It is also not beyond our hopes that the Navy Yard workman, seeing the efforts which the government is exerting to make his surroundings pleasant while at work, will apply the same efforts in his own home life. Let us then look after the health, comfort, safety and general welfare of the Navy Yard mechanic on shore in the same way that we do for the men on board ship, and the result can only be increased efficiency.

CONCLUSION.

The foregoing has been an attempt to outline methods whereby economy may be practised in the administration of navy yard affairs. In so doing, the author has had continually in mind the policy of ultimate economy, and it is firmly believed that nothing has been suggested in the preceding pages which would prove economical at first but expensive in the long run.

The true test of navy yard efficiency will come when the stress of war is felt upon the system of management and the details of administration. Until that time the efficiency of a yard is problematical, so far as its military value is concerned. The

yard is maintained for the fleet, and, if in war time the yard should, for reason of certain policies maintained in peace time, fail in its duty to the fleet, who can tell what losses may occur? In the event of disaster our policies and economy become a mockery. In considering any system for the navy it is well to keep continually in mind the ultimate object of a navy. To attain this ultimate object we can only repeat with as much emphasis as possible our guiding principle that "the best is none too good" for the navy.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AN ATTEMPTED CLASSIFICATION OF THE PERSONNEL OF THE U. S. NAVAL DISCIPLINARY BARRACKS, PORT ROYAL, S. C.

By W. L. MANN, Ph. B., A. M., M. D., Passed Assistant Surgeon, U. S. Navy.

The genesis and development of punishment have been divided into four periods.[1] (1) *"Retribution,"* vengeance, or vindictiveness constituted the sole object of all punishment in the days of the primitive man, the patriarchal system, and the tribe. (2) With the steady advance of civilization *"Repression"* of offenses became the primary consideration of punitive measures. This was attempted by intimidation and torture, the methods of which are so conspicuously recorded upon the pages of history. (3) The deep thinking of the Beccario and the indefatigable labors of John Howard gave a decided impetus to the third epoch, which has been termed " Reformative " period. During this time it was recognized that reformation of deliquents was not only beneficial to the individual, but indirectly aided in the prevention of offenses. (4) We are now on the threshold of the new epoch. Profound students of sociology and practical laborers in our great penal institutions are realizing the importance of prophylaxis or prevention of offenses over therapeutics or treatment of offenders. They now consider that the application of remedial measures to the affected individual after the manifestation of a pathological condition is by no means as efficacious in the reduction of the number of offenses as the removal of contributing, predisposing and exciting causative factors. In consequence of this, the last era has been termed the " Deterrent " period.

The navy, in accord with the most recent views on this subject, has established the U. S. Naval Disciplinary Barracks at Port

[1] Wines, F. H.: Punishment and Reformation.

Royal, S. C., which institution has for its primary purpose the reformation of military offenders. At the same time it assumes that the restoration of reformed offenders to active service will utilize to the maximum advantage the deterrent action of the punitory methods now enforced at this station.

Many modern sociological writers on this subject advocate and predict the future adoption of the "indeterminate sentence" in penal administration. The discharge of probationers at this station upon the expiration of their enlistment partly involves this penological principle.

The enlisted personnel of the navy is recruited from a varied aggregation, containing individuals in nearly every walk of life who enter the service for various and sundry reasons. At the Disciplinary Barracks, as is sifted out, we find individuals presenting type characteristics of almost every class in this heterogeneous collection. The efficient petty officer who, by the fact of this very efficiency, was caused to be placed in a position of responsibility and perhaps suffered from a culpable error in judgment (from a military standpoint), here stands in bold contrast with the indolent individual, who will be a failure in any calling.

A classification of any personnel according to personal characteristics is a rather difficult and indefinite undertaking. Man, according to psychological analysis, is a composite and complex organization, and the division of a personnel according to the predominating traits of character must necessarily be arbitrary and temporary. What might be termed *capability of adaptation to external environment* is remarkably prominent in some individuals, and a future change in their environments would so influence their personality that a different classification would soon become necessary. Notwithstanding all this an "attempted classification" will be undertaken, because at this station there is such conspicuous contrast in the characteristics of the different classes of this personnel.

CLASSIFICATION OF PERSONNEL.

The personnel of this station are classifiable into three categories according to the *degree of adaptability*. The first class was subdivided according to *degree of culpability;* the second according to *personal characteristics;* and the third by the *cause* of inaptitude. Five hundred and thirty of these offenders were

grouped into the following classes by the co-ordination of the opinions of three observers.

CLASS A. ADAPTED.

Capable, efficient and adapted for the service. Number 114, or 21 per cent.

(1) Inculpable, but unfortunate. (9.)

(2) Culpable, but actuated by some temporary morbid psycological condition. (105.)

CLASS B. ADAPTABLES.

Potentially capable and probably eventually desirable for further retention in the service. Number 297, or 56 per cent.

(1) Ignorant and inexperienced. (115.)

(2) Indifferent and irresponsible. (149.)

a. Lethargic.

b. Misapplication of excessive energy.

(3) Lacking in self control as intoxicants, irritability of temper, insubordination, etc. (33.)

CLASS C. UNADAPTABLES.

Unadaptable for service conditions. Number 119, or 23 per cent.

(1) Mentally deficient. (32.)

(2) Morally undesirable. (45.)

(3) Physically unfit. (29.)

(4) Military recidivist. (13.)

CLASS A.—Adapted for service conditions.

(1) Inculpable, but unfortunate. This category is closely connected with the "accidental" culprit.[2] Many in this class are what might be termed victims of misfortune; some are perhaps culpably negligent only from a military standpoint. Perhaps some in this class took the blame to shield others. One striking example of this is an experienced person of middle age. His appearance and conversation characterized him as an individual accustomed to the better walks of life, and at a glance he could easily be picked out as a man of exceptional ability. His conduct up to the time of this misfortune had been perfect, his performance of duty

[2] Henderson, C. R.: Dependents, defectives and delinquents.

excellent, but unfortunately he was involved in a combination of circumstances and given a general court-martial. There is reason to believe that had he related all he knew the blame would have been partly shifted, but he, true to this type, refused to involve others. While at this station his clerical and executive ability made him almost indispensable.

(2) Culpable, but degree of guilt modified by some morbid psychological condition or incited by some temporary uncontrollable impulse. This includes the experienced individual who served many years with a fine record, but for some unexplainable reason his manner of performing his duties become temporarily and often suddenly changed. Morbid psychological may account for some of these irregularities; perhaps some are species of "eccentric activity," recently described by the late Professor James. At other times domestic infelicity, financial or other misfortune may actuate as a cause to dishearten the man and make him negligent, irresponsible and perhaps dissipated.

A man's power of sustaining responsibility year by year is limited, and a temporary abeyance of this power naturally takes place when actuated by any of the above conditions. It is reasonable to suppose that a man with two or three "excellent" or "very good" discharges, who has served ashore and afloat under different commanding officers in various climates, and under varying vicissitudes of circumstances, who, suddenly but repeatedly, commits offenses, is manifestedly incited by some morbid condition.

The relief of all responsibility and the removal from temptation to this station may serve to protect the individual from further degradation and save him to the service. A sudden psychological shock, such as placing them in detention, to some of these old-timers may often serve as a stimulus for an increased endeavor to fulfill the navy regulations.

CLASS B.—Adaptable for the service. Potentially capable and probably eventually desirable for the service.

(1) Ignorant and inexperienced. This class includes the young and inexperienced with undeveloped judgment and discretion. The training station serves to adapt the majority to service conditions, but in some cases, due to the personal equation of the individual, this adaptation is incomplete and disciplinary measures are necessary before complete adaptation is effected. A certain percentage,

e. g., engineer's division, many of which are direct from the rural districts, are thrust suddenly into the *military* and *nautical* life. The suddenness and greatness of the change in their surroundings, without preliminary training, causes some to be victims of nostalgia. The chronological age of an individual is not always a reliable index of previous experiences, as the following case illustrates:

This individual was a college graduate, possessing both a bachelor's and master's degree, and soon after graduation, at the age of twenty-two, he entered the service. He was industrious, intelligent and energetic, and with the exception of the performance of his scholastic duties he had never been thrown upon his own resources. He had lightly regarded his former offenses. An unintentional prolongation of a previous night's celebration created the offense. The almost daily association with this person leads me to make the unqualified statement that by his restoration to the service the navy will gain one whose proficiency in rating and obedience will be better than ninety per cent of those now in actual service. The former system of punishment would probably have proved the ruination of his future life and his valuable services would have been lost to the government.

(2) Potentially capable and efficient, but indifferent and irresponsible. (a) Individuals of this class are lethargic, but stern punitive measures awaken latent possibilities. Some present traits of character, peculiarly indigenous to a certain section of the country. They have a well-developed sense of honor, yet are lacking in ambition, indifferent to their surroundings, and spend their time in day-dreaming. But the humiliation of a court-martial for culpable inefficiency suddenly awakens their dormant potentialities. The offenses of this class are usually negligence and crimes of omission.

(b) Others of this class are energetic and capable, but appear to be devoid of any sense of responsibility. Their self-satisfaction and surplus energy seems to get them into trouble. They are possessed of excellent executive ability and initiative, and are willing workers, but appear to be unable to distinguish pleasure from labor; life to them is not serious enough. They correspond very closely to the mischievous boy of younger years. The process of adaptation of this class to service conditions is so difficult

and indefinite that their retention seems questionable. Their misdeeds are generally crimes of commission and not of omission.

(3) Apparently efficient, but lacking in self-control, due to insubordination, intoxicants, irritability of temper, etc. This class may be known as the "occasional" offender. Short, severe punishment, as a sentence to solitary confinement on restricted diet, is apt to further antagonize the members of this class and lead to recidivation. A milder, but prolonged punishment tends to lead them to gradually see their error and a uselessness of acting contrary to military rules and regulations, which have been the "survival" of the most suitable laws of one of the oldest professions known to history.

Often the person with the strongest character will resist this adaptation of self to sudden changes in environment, yet eventually but gradually he will absorb the immutable and ancient customs and usages of military life and may finally prove more efficient than his weak companion, who is easily influenced by all conditions, good or evil. After the period of adaptation some develop into ideal petty officers. The correct diagnosis of this type from class C is only possible after a protracted period of observation, and thus may account for the lower restoration percentage. It appears advisable that *every effort should be made* to effect an adaptation of this class to service conditions.

One man of this class was formerly a student at a large eastern university, and while in a depressive mental state following an extended debauch he enlisted in the service. According to authentic written information he possessed considerable financial means. When it was suggested to him that his sentence at this place might be mitigated he refused, saying that "he was going to stick it out and fool the old man." Evidently disciplinary action had succeeded where education had failed, thus illustrating the reciprocal relation of instruction and punition in the elevation of human efficiency.

CLASS C.—Unadaptable. Undesirable for the service.

(1) Mentally deficient. Naval conditions exact a certain amount of intelligence. The average individual is able to fulfill these requirements, but there are some, endeavor as they may, who are *inculpably incapable* of the proper performance of the duties of their ratings. Others, while possessed of sufficient mentality, yet are inherently and temperamentally disinclined to this sort of

life, or, as it is sometimes colloquially expressed, "a good farmer ruined."

Four cases of defective mentality have been surveyed. The diagnostic methods of psychopathy are often so difficult that some cases of psychosis and psychoneurosis may escape detection of even a specialist after a prolonged period of personal observation. In my opinion, 2 to 10 per cent of these offenders are mentally irresponsible and possibly should be, or eventually will be, in an institution for the insane. Many present the various stigmata of degeneration. Others, who possess limited responsibility, comprise a comprehensive group existing in that broad domain which lies between the sane and the insane. One person, according to his letters and conversations, has aspirations to be a great detective; a portion of a rusty revolver was found in his possession. Another was encumbered with presumably abnormal religious zeal. Still another eccentric (?) was an inventor of many interesting mechanical devices.

(2) Morally undesirable. The majority under this classification could be grouped in the above, yet there are exceptions, as the following case illustrates:

A patient was court-martialed for fraudently re-enlisting. Previous to a surgical operation, while in the second stage of etherization, which was unusually prolonged, he gave his real name, which was different from the two on his enlistment record. In this state he quoted at random sketches from various noted writers, delivering at times rambling discourses on different subjects couched in excellent scientific diction, thereby indicating an intellect and an education above the average. But interspersed with these intellectual subjects he indulged in profanity and topics of depravity of the worst immoral nature imaginable. Later he has been very reticent concerning his past; he claims to have studied medicine. His mentality is apparently warped; a genius in some lines and an imbecile in others. Certain evidence suggests that he is a hypnotic habitué. He reminds one very forcibly of a certain well-known literary genius of the past century. This class includes the dipsomaniac, the cocaine and morphine users. It also includes the criminal type, who, by chance, were first detected in committing a military offense. One person admitted that he had been sentenced to seven years in the penitentiary for theft.[3]

[3] This was admitted to a general court martial. The data contained in this article has been verified as far as possible.

(3) Physically unfit. The equilibrium of human efficiency is nicely balanced by numerous factors. A temporary deficiency or defectiveness of one of these factors, such as temporary indisposition of health, will produce little effect in the efficiency of a normal person. There is a struggling class that soon succumbs to adverse circumstances when one of the factors are in abeyance. The medical officer attending "mast" is frequently impressed with the strikingly large number of his repeated sick bay visitors present among the offenders.

This class includes a familiar type known to the medical officer. Objectively they are fit, but subjectively they are incapacitated for duty. They complain of pains in chest, backache, weakness, and the like. Many can be classed under the comprehensive, yet ever narrowing diagnosis of neurasthenia. Repeated physical and laboratory examinations are negative. It is possible that some are suffering from incipient or latent disease that would baffle detection by all known means of medical diagnosis. A Wassermann reaction has served to clear up a suspicious diagnosis in some of these cases. Still further advance in medical science *may materially lessen this type;* for example, as the recent discovery of the detrimental influence of certain intestinal parasites (hook worm) upon the *efficiency of the affected person has demonstrated!*

A coal passer was court-martialed for failure to perform duty and sent to this station. He claimed that he was physically unable and became a constant visitor at sick call. Repeated examinations were negative and he was considered a malingerer or a hypochrondriac. Later he developed clinical symptoms of consumption and was given a medical survey. There is reason to believe that the incipiency of this disease might have been a casual factor of the offense.

CLASS D.—Military recidivist.

This class corresponds to the habitual criminal or "recidivist," a well-known type to the criminologist. To these persons violation of the rules and regulations is a mania. They violate the rules without any apparent motive of gain. Numerous uninteresting cases of this type could be quoted. In this class we find the habitual liberty breaker and repeated violators of minor regulations. They seem to gain delight in being detected and punished for their infractions. It is said that one man boasted of never

CLASSIFICATION OF OFFENSES.

Class.	Total.		Average age.	Average service.	Average sentence in years.	Restoration percentage.	Rates.				Offenses.						Disposition.				
	Disposed of.	Undisposed of.					Mariners.	Seamen.	Engineers.	Artificers.	Absence.	Fraudulent enlist.	Disobedience and neglect.	Drunkenness.	Assault and abus. lang.	Scan. cond. Pred. cond.	Restored*	Discharged†	Deserted.	Med. survey.	Ret. to pris.
A. Adapted.																					
A—1	5	4	28.87	7.68	.650	100	5	2	....	....	4	....	5	....	....	....	5	....	....	....	....
A—2	59	46	27.43	5.02	.748	100	19	36	34	16	54	7	11	22	4	7	59	....	....	....	1
B. Adaptables.																					
B—1	78	37	20.95	1.23	.682	100	11	62	35	7	68	20	17	1	....	9	78	....	....	....	....
B—2	64	85	24.96	2.05	.794	91	50	33	56	10	66	43	17	8	2	13	58	4	1	....	1
B—3	29	4	25.71	1.37	.855	1.3	5	11	13	4	11	10	5	2	4	1	4	24	1	....	....
C. Unadaptables.																					
C—1	25	7	24.03	2.21	.800	0.4	9	12	9	2	13	10	8	1	....	....	1	18	2	3	1
C—2	39	6	21.8	1.2	.980	2.0	6	22	13	4	16	16	4	2	4	3	8	17	4	....	10
C—3	20	9	25.2	1.55	.837	1.0	9	8	11	1	11	6	5	2	3	2	2	4	....	13	1
C—4	9	4	21.6	1.06	.805	0.0	4	7	2	....	6	5	....	....	1	1	....	9	....	....	....
Total	328	202	....	....	....	....	118	193	175	44	249	117	72	38	18	36	215	76	8	16	13

* Includes those discharged but recommended for re-enlistment.
† Includes all discharged who were not recommended for re-enlistment.

INDEX OF RESTORATION FOR VARIOUS OFFENSES.*

Absence	75.54%
Fraudulent enlistment	58.02%
Drunkenness	66.60%
Neglect, disobedience, refusing to obey	53.48%
Scandalous and prejudicial conduct	63.63%
Miscellaneous	33.33%
Average of total	65.52%

*See U. S. Naval Medical Bulletin for a more complete tabulation of offenses.

reporting from liberty on time, and one day when he saw that he was returning on time he deliberately waited for the next boat.

Infractions of regulations seem to be an obsession to this class, corresponding somewhat closely to burning, stealing, and drinking to the pyromaniac, kleptomaniac, dypsomaniac, respectively. One individual, apparently possessing the average intelligence and normal in all other respects, was considered mentally irresponsible for his recidivistic tendencies and was discharged on a medical survey. Leniency, admonition, rigorous and cumulative punitory measures appeared to be totally ineffective in producing a detectable change in his antisocial conduct.

REMARKS AND DEDUCTIONS FROM ABOVE FIGURES.

The more or less harmonious correlation of the various factors forcibly suggests the presence of some fundamental basis for this classification.

The small number, relatively speaking, of marines and seamen in class B illustrates the value of training stations and recruit depots in adapting individuals to service conditions. This, however, is not strikingly demonstrated.

The average period of sentence seems to vary inversely as the adaptability.

Unfortunately among the old timers (class A) intoxicants appear a rather potent etiological factor. The significance of alcohol as the instigating cause for some of the offenses is not fully demonstrated in the figures.

Minor discrepancies might be attributed to coincidences caused by the insufficient number of statistics.

Naturally the offenses of the artificers branch are not so grave.

The restoration percentage as a rule is influenced by the gravity of the offense, or, more properly expressed, is regulated by the motive inciting the offense. Compare absence with a restoration percentage of seventy-five to assault with a restoration percentage of twelve.

Obviously, the military recidivist could not exist long (average 1.06 years) in active service. Their youth (average 21.6 years) suggest that they are still in a developmental state, and that some may eventually, unless corrected, suffer severe penalties for their propensities.

In conclusion I would like to state that the personnel of the U. S. naval disciplinary seems to present as marked variation in degree of human efficiency, considered intellectually, morally, and physically, as can be found in active service. In fact, it would appear that there are very few other places which would present a personnel on the *same social status,* where there is such a difference between the maximum and minimum capabilities of the individual units.

MARITIME AVIATION.[1]

By CAPTAIN RENÉ DAVELUY, French Navy.
Translated by LIEUTENANT G. M. BAUM, U. S. Navy.

At the present time, while there is a decided increase of public interest in favor of aviation, it is hardly out of place to consider the form and manner in which it can be adapted to the needs of the navy.

It is true that the question does not present itself to many people. The air is essentially the domain of aviation. It is therefore of little importance whether the aeroplane flies over the sea or the land; in both cases it remains in its element and there is no difference between maritime aviation and terrestrial aviation.

This reasoning might be correct if the "avions" never came in contact with our terrestrial envelope, but in reality the time they are actually in the air is relatively short; their employment does not extend beyond flights of short periods; the means at their disposal for taking flight and landing have primary importance, because they are the means which determine their employment.

The proof of this is that the apparatus of the Wright Brothers did not have, in its primitive form, more than an ephemeral existence, in spite of its excellent performances. In order to take flight the apparatus needed the assistance of a tower, a car and launching ways. It could not, therefore, make anything but round trips and if unforeseen circumstances forced it to land during its flight it was not capable of resuming its flight.

To emancipate the aeroplane we continue to fit it with wheels, and it is only thus that we can pretend to use it in a military or sporting enterprise.

While aviation over the sea was dreamed of, it seemed that our first concern would be to adapt the aeroplane to its field, which immediately led us to consider hydro-aeroplanes. Such was not

[1] "La Nouvelle Revue," September 15, 1912.

the case and maritime aviation with aeroplanes used on shore was at once considered. In fact, that is one of the peculiarities of our natures, that we do not seek to adapt the means to the end; we have rather a tendency to use a means with which we are familiar and alter the nature of the end.

Maritime aviation was therefore imagined in the following conditions:

The aeroplane leaves the earth, flies over the sea, and, its mission ended, returns to the shore. The same apparatus could likewise be embarked on board ship; the ship need only be fitted with a platform of sufficient dimensions to permit the departure and return by ordinary means.

The problem of maritime aviation thus presented itself in a very simple form and was susceptible to immediate application; but these indisputable advantages were not without serious inconveniences, which we shall try to set forth.

Aeroplanes—whether they fly over the land or over the sea—are subject to the same casualties. Statistics show that they are very frequently obliged, while in flight, to make forced landings. These stops can be caused by infinite diverse causes, of which there are too many to enumerate here; but the fact remains that they must be endured. In a case of this kind the pilot is forced to find a convenient landing place; he may succeed fairly well and finally, if he is skillful, he generally lands without too much damage.

Over the sea an apparatus fitted with wheels, which is forced to descend on account of an accident, cannot rest on the surface of the water if it is not constructed to float; it is therefore obliged to drop into the water, and the fall can have serious consequences. The frame striking the water acts as a powerful brake and the apparatus capsizes. Now, capsizing has never been considered a natural function of the aeroplane; it is favorable to neither the apparatus nor to the pilot; at sea it can be fatal to the latter if he is imprisoned in the wreckage.

With or without capsizing, the ordinary apparatus always ends its run when the motor fills with water. It was hoped that placing a float in the frame would suffice to keep it on the surface; but the tragic flight of Lieutenant Bague and Cecil Grace has proved that this means is insufficient.

If, on the other hand, one limits himself to preventing the sinking of the aeroplane by means of a makeshift, it will be so damaged after a sojourn in the water that it will be of no further use. Therefore, it is necessary to the navy that hydro-aeroplanes be specially constructed so as to rest on the water like sea-gulls; and it would be just as illogical to wish to fly over the sea with wheeled apparatus as to fly over the land with apparatus fitted with floats.

It has been feared that the equilibrium is disturbed by the floats and that unstable equilibrium in the air results; it has been feared, likewise, that the landing on the water presents the same dangers to an apparatus with floats as to the others in respect to capsizing. These apprehensions faded away at the Monaco meet, where the success was such that it was regretted that aviation had not first started over the water where it has found guarantees of security which the land does not offer.

The reasons which we have pointed out above are not the only ones coming up to prohibit the use of ordinary apparatus in the navy. We can not dream of developing maritime aviation without considering the embarkation of aeroplanes on board ships. We have seen that, to adapt the processes which have been tested on shore to use on board ship, it has been advocated to construct a platform for the departure and landing of the aeroplane on ships specially designed for aviation. The Americans have made an experiment of this nature, and the success of the venture has given rise to the belief that the problem has been solved.

It will be remarked that Ely's experiment was not an every-day occurrence. Perhaps it is not rash to conclude that the feat accomplished by the brilliant American pilot has not been considered susceptible of continued application. If it had been otherwise the attempts to accomplish these tests would certainly have been made by different pilots.

We could not, on the other hand, draw positive conclusions from that remarkable experiment, because it did not simulate practical conditions; the arrival and the departure took place on a vessel at anchor. Has the test been made in the open sea on a vessel subjected to rolling and pitching? We doubt it.

Without doubt favorable times will always be sought for the departure of the apparatus; a calm of several seconds during the rolling and pitching will suffice. The departure, therefore, has

not appeared to present insurmountable difficulties, even in a rough sea-way, at least on a ship of large tonnage; but such will not be the case for the return under the same conditions. The landing is always a delicate operation, and the best pilot cannot flatter himself with being able to land in an infallible manner under all circumstances; now, in the particular case which we are considering, the aeroplane, before touching the landing platform of the ship, will fall into the eddies caused by the hot gases from the funnels, while the smoke will mask the view of the pilot at the very moment when he must execute a precise maneuver. To these causes of difficulties are further added the rolling and pitching, which, however gentle they may be, will swerve the apparatus which commences to roll on the platform. It will require a truly fortunate series of circumstances to accomplish it; a bad landing could have very grave consequences. It evokes in our mind a tragic spectacle; the aeroplane crashing against the superstructure, the punctured fuel tank allowing the inflammable liquid to flow on the platform, the pilot struggling in the midst of the flames, the fire gaining hold on the ship.

Without doubt, one will hesitate before risking the dangers to the ships and to the aviators. That is why it seems that the aeroplane on board ship must be an apparatus with floats which takes its flight with the aid of a mechanical contrivance and which, after having accomplished its mission, returns and rests on the water alongside the ship; it will then be hoisted on board like a ship's boat.

For the departure, therefore, we must return to a system similar in principle to that employed by the Wright Brothers; this system of launching, while of no assistance to shore aeroplanes, satisfies, on the contrary, the conditions of maritime aviation quite well, since the apparatus on board ship must always return, not to the point of its departure, but to its ship.

The apparatus should be easily dismountable in such a manner that, with its wings folded alongside its frame, it will not take up more space than a boat. It will then be possible to take one or two aeroplanes of this type on board each ship of large tonnage without their being an encumbrance.

All that we have said of maritime aviation has established a distinction between the apparatus on board ship and the apparatus on shore. The latter, especially applicable to the defense of the

coast, is easier to conceive, because it is not required to satisfy as rigorous conditions as the apparatus on board ship. In fact, all hydro-aeroplanes can be classed as coastal apparatus; many of the different types have already been seen to function satisfactorily at Monaco. It should be mentioned that the navy will not be able to use apparatus which will take flight from the surface of the water only, because the departure should not depend upon the state of the sea.

Further on, when we take up the question of definite organization of aviation, we will discuss whether the navy ought not to be content with one special type. In the meantime it is better to test the apparatus immediately at hand, because the results obtained with these will facilitate the study and development of the model aeroplane. For this reason the coastal apparatus and the others must still actually take part in the program.

Having apparatus suitable to the needs of the navy is not sufficient; we must know also what we want to do. In short, the military utilization of aviation does not present itself to the navy in as simple a form as to the army. Some urge confidently the necessity for introducing aviation into the navy, but they fail to specify—for reasons—how one could utilize it. Others confine themselves to pointing out a vague objective, such as reconnaissance, without describing the manner of performing it.[2] Still others set up a program on so fragile a foundation that it does not survive a simple examination. All of them limit themselves thus to presenting the problem, leaving the work of solving it to the navy.

If it is merely a question of imagination, it is easy to see vaguely a whole series of applications of aviation to the navy; we will not reproduce here the enumeration frequently made. On trial it is seen that it may be necessary to set aside the first expectations; it is quite possible that the solution will come from a direction in which we had least dreamed that aviation would render the greater service. But we can state now that aviation will in no way modify the character of naval warfare; it will introduce a new element which will add to the means already at hand;

[2] In short, one cannot undertake reconnaissances in aeroplanes before having expounded the question of the installation of wireless telegraphy on aircraft, and of the determination of the position of the apparatus in the open sea.

nothing more. Those who imagine too extravagantly that the aeroplane could annihilate the fleets should go into mourning. Actually aviation is not an arm; it is a means which, under certain circumstances, facilitates the employment of the arms, and thus increases their efficiency. The designation "fourth arm" given to military aviation is therefore improper and can give rise to fantastic hopes.

The question with which the navy is burdened at the present time consists partly of perfecting the hydro-aeroplane in such a manner as to create a type especially adapted to the conditions of maritime aviation; in addition, it is to determine the nature and the extent of the services which aviation can render to the navy from a military point of view.

With a view of attaining this double objective a decree and a ministerial notice were promulgated, "containing the organization of maritime aviation." This provides for an aerodrome, a central ship and, eventually, flotilla ships.

The aerodrome will be established on the shores of Provence, in Saint Raphaéls Bay.

We are amazed to see aviation established at this point when we have been led to believe that it had better be located in a fortified port. It has been generally believed that aviation had entered unceremoniously into the period of utility. This makes no difference, for aviation will not take a definite form until it has been thoroughly developed. The preliminary studies cannot be made except on an experimental field, that is, an aerodrome. Now, an aerodrome does not exist—and cannot exist—in the interior of a fortified enclosure. On account of their dimensions and the conditions with which they must comply, all aviation fields are located on open fields; we are lucky if we can find a field which extends at least six kilometers from the center. The naval aerodrome is subject to the same requirements as a shore aerodrome; it is further necessary that it be on the seacoast, in a sheltered bay that is sufficiently deserted so that the hydro-aeroplanes will not be hampered in their evolutions. It was therefore placed where it was possible to place it and not where it was desired to place it.

The central ship and the flotilla ships will permit the experimental field to be extended and maritime aviation will then have

a sufficient field of action for solving the problems brought up by the application of aerial navigation to the navy.

There is no need of a large number of aviators for the solution of these problems. The execution of an experimental program is impossible except with a chosen personnel, and the quality is more important than the quantity. If the navy should develop too many pilots at the present time, or if they should accept inexperienced aviators, it would be difficult to keep them busy and they would be limited to circling round and round the aerodrome. This should be avoided at any price, because there is nothing more depressing than flying in a circle.

The actual organization has, therefore, no definite character. Meanwhile, the plan does not consist of transitory measures in a sense that the development which aviation could subsequently undergo will not modify the actual state of things; the new organs will merely replace those now existing without overthrowing the latter.

What will aviation then be—or, above all, what can it be—when the navy has in its possession apparatus adapted to its needs, and when it knows their applications? That is what we now wish to investigate.

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* *

It is generally considered that the organization of aviation consists essentially of the development of pilots and the acquisition of apparatus. This is a serious mistake. The instruction of flying officers and the purchase of aeroplanes is merely a question of funds, which can be solved quickly with the means at hand in France. The difficulty is, after we have apparatus and pilots, to know how and to what end to employ them.

Organizing aviation is familiarizing the pilots with the military duties which they will have to perform in time of war; it is placing the apparatus at the disposal of the different units with which they are to serve in such a way that the corps commanders know what they can require of them and under what circumstances they can be made use of. In a word, it is to incorporate aviation in our military organization in order that it may render the services expected of it from day to day.

If after two years the army has done nothing further along this line, if no further permanent disposition has been made, it is

because the thing is more difficult than it was thought to be. Many plans have been proposed; not one has been adopted, and the new military aeronautics law has left the question in suspense.

In the meantime the present state of affairs cannot continue, because aviation does not suffice to occupy its personnel, and there is much leisure time in the life at the aerodrome, especially in winter. After an officer has qualified for a military brevet he has nothing more to do in the field of aviation. In qualifying pilots the army and navy had nothing but their utilization in military work in view. That utilization is not encountered in civil aerodromes, where aviation can have only a sporting character. It cannot be found anywhere outside of a corps of troops. The flying officer, once qualified, should therefore participate in military exercises with his apparatus; but since the maneuvers which include the employment of aeroplanes cannot, on account of their nature, take place except at irregular intervals, the flying officer should, during the intervals, lead the same life as his comrades.

If, their instruction completed, the flying officers remain attached to an aviation field, their occupation would have nothing of a military nature and the surroundings in which they live might cause them to lose sight of the exclusively military objective which aviation should pursue. This is a reef from which our officers should be saved.

It is necessary to definitely place the flying officers in a position analogous with that of officers of the cavalry. If these did not preoccupy themselves with anything but equitation, they might be "horsemen," but they surely would not be cavalry officers. While it is said of LaSalle that he was a brilliant cavalryman, it is not recalled that this general handled his mount in a particularly brilliant manner; this, more than everything else, indicates that he understood the role of the cavalry and knew how to use it. Later, it will be said also of certain flying officers that they were "wonders," that with their "cou cou" they knew how to render immense services to the army. They who imagine that all that is needed to be a flying officer it to become a pilot understand nothing about aviation in war.

It seems that the navy will find more facilities than the army when, having taken count of the services aviation can render it, it wishes to proceed to a definite organization. In reality, the

marine apparatus will always be followed in all its uses by its hangar, its accessories, its spare parts, since all these things will be found on board the ship on which it is embarked. One can therefore have a glimpse of the functioning of maritime aviation in a very simple form; the flying officers, their instruction finished, would be embarked on the ships destined to receive aeroplanes, in the proportion of one officer to each unit. On board they would contribute to the general service and carry out the duties of their specialty, like gunnery and torpedo officers. When the aeroplanes are to take part in squadron exercises, these officers will be relieved from watch standing in order to man their apparatus. Between times, in order to keep in form, they should make flights under conditions that will keep them abreast of the service. As the gunners exercise regularly between firing practices, so ought the aviators assure themselves periodically of the proper functioning of their apparatus.

These flying officers would not be in excess of complement, because they would replace officers who have no specialty. Each of them would be accompanied by two mechanics and would have two apparatus at his disposal.

The naval aerodromes would continue to perform the work of qualifying pilots and mechanics, making acceptance trials, developing new apparatus for service, and making major repairs which the ships cannot make with the means on board. The aviation center would then be the base at which the ships are fitted out with personnel and materiel. Its permanent staff should consist of not more than four or five officers, including the chief of the center. Regarding the central ship, which will have served for the studying and employment of aeroplanes, it will have no further reasons for existing, and would disappear, because further research into the uses of aviation would not be necessary; its role would be precisely defined, and there would remain nothing further than to get as near as possible to practical conditions. All our naval forces will be used in this work.

In this way the definite organization of maritime aviation, that which we should be able to substitute later for the existing conditions, would appear to us to necessarily include: on the one hand, flying officers and mechanics embarked with their apparatus on board battleships and armored cruisers; on the other hand, a naval aerodrome as a base of supplies for aeronautical material.

It may then be necessary to have a central administrative organ at Paris, centralizing the requests of the different naval forces for materiel and personnel, and making purchases. But that central authority should have a distinctly administrative character, because one of the serious mistakes of our administrative system is the delegation of power of management, often the same as military power, to irresponsible and incompetent bureaus, to the detriment of commanders-in-chief, who are the only ones detailed by the minister and are alone directly responsible to the state.

In the preceding it has not been a question of assigning a ship specially constructed for transporting aeroplanes to the fleets; on the contrary, we have urged the embarking of two apparatus on each ship of large tonnage, because the first solution would be too onerous (since it involves the expenditure of 15 millions to provide for several aeroplanes of about 30,000 francs value), and, above all, because it would confine aviation to too narrow limits. It is evident that if all the apparatus are assembled on the same ship their field of action will be around their ship only. Superfluous means would then be centered in a single point. It seems more military to extend the field of action of aeroplanes as much as possible by embarking them on all ships large enough to receive them without its being necessary to sensibly modify their construction.

* * *

The organization of which we have given the main outline contains a void, a serious void; it does not consider the participation of aeroplanes in the defense of the coast. That omission results from the inward conviction that, confining it to the limits outlined, aviation satisfies all the needs, answers all the requirements. To establish coast stations would, in our opinion, be to waste money uselessly, to create useless and encumbering organs, to multiply useless employments.

That assertion will undoubtedly appear quite bold to those who have impelled the navy toward aviation; because most of them saw above all else, in maritime aviation, a means of increasing the security of the sea coast.

Therefore it remains for us to defend our opinion and to justify it if possible.

For many people naval warfare resolves itself into a struggle between the shore and ships. Such a false conception was without doubt born as a sequel of the three last maritime wars—the Chinese-Japanese, Spanish-American, and Russo-Japanese wars. The fleets are seen prowling around the enemy's port: Wei-Hai-Wei, Santiago, Port Arthur. But if the cause of this fact is shown it is ascertained that each time these fleets have been drawn by the presence in each of these ports of the naval forces of the adversary. The ships did not seek to enter into an engagement with the shore; they came to attack the enemy afloat. To force the enemy to come out or destroy himself in his lair, it was necessary to disembark entire army corps, besiege the shore fortifications, deliver assaults, and at Port Arthur to sacrifice 100,000 men. This evidence proves that ships are powerless against the shore, and that in naval warfare all the interest of the war is centered on the destruction of the enemy afloat.

This established, what service do you claim for aviation from a coastal point of view?

Do you pretend to establish a continuous surveillance with aeroplanes all along the coast, with the idea of discerning the presence of an enemy who will probably never appear? The realization of such an intention would produce fantastic results; we must then count aeroplanes by thousands instead of by hundreds. Furthermore by increasing the number of apparatus infinitely, the surveillance will never be real or efficacious.

It will not be real because the ships generally take pains to arrive in sight of the coast in the early morning, and the aeroplanes will not discern them until the same moment that the semaphores signal their presence. Furthermore, as the assailant can select his own time and as our new battleships of more that 20,000 tons can disregard the state of the sea, it will always be possible for him to select weather which will paralyze the torpedo boats and aircraft. Meanwhile, the navy need not imitate the monkey of the fable in this question and forget to light its lantern.

The surveillance will not be efficacious. In reality, the signalling of the presence of the enemy does not prevent the coming attack; the sole benefit is a delay of security which, when it is sufficient, allows an organization of the defense. Now, the zone of action of a coastal aeroplane cannot be very extended; so that under the most favorable circumstances the delay of security will

be too short or too long. It will be too long if it is merely a question of the personnel manning the batteries for action; the spyglass of the signalman suffices for this. If, on the contrary, it is necessary to move troops to repulse a landing, then, in the latter case, the aeroplane is totally insufficient.

Moreover, this discussion is idle. It is not by the aid of a feebly carried-out surveillance that one can prepare against attack on the coasts. From the beginning of hostilities contact with the enemy's forces is sought and his movements are followed. This duty is assigned to the naval forces. It is they who must also protect the coast from bombardment and from the landing of hostile troops by keeping the enemy in check and attacking it if it can be done with a chance of success. Thus, by removing from us the preoccupation of giving a role in the defense of the coasts to aviation at any cost, the true conception of war can be grasped. We do not count on saving the country by describing small circles tangent to the seashore with aeroplanes, surrounding it with an aerial chain. That conception of war is childish. If France never tries to realize it, the disillusion will lead unjust opinion against the aviators; when one sees the enemy showing itself in spite of the aeroplanes, one will accuse them of treachery.

Suppose, on the contrary, that an inferior naval force has been obliged to take refuge in a port, as was done by the Chinese fleet at Wei-Hai-Wei, the Spanish division at Santiago, the First Russian Pacific Fleet at Port Arthur. They will be fatally followed by the enemy, which will establish itself on guard in the offing, ready to sink them if they come out.

This condition, due to one of the participants being inferior, which has come up in the last three wars, will undoubtedly come up again in future wars. Thus the utility of aeroplanes on the one side as well as the other is clearly conceived.

The attacker—that is to say, the blockader—will require aviation to reveal the whole system of defense of the enemy's position; to locate the position of mine fields; to report the presence of submarines; to determine the number and composition of the blockaded forces; to submit reports of the results of each engagement; finally, to give daily assurance that the enemy's ships have not escaped during the night.

The defense—that is to say, the blockaded force—will require no less important service of its aeroplanes. It also will have to

guard itself against mine-fields and submarine attacks. It must know the nature of the enemy's forces. Blockades are not generally made with other than smaller vessels and destroyers; it is therefore necessary to ascertain the position of the main forces and to determine the plan of action adopted. Thanks to this information, the blockaded force might be able to evade the other at night and gain a more favorable field of operation without attracting attention. In the meantime, it must tire the vigilance of the blockader; make frequent sorties; and, in order to have chances of success, it must be assured of the position occupied by the different forces of the enemy. The aeroplanes will thus have a vast field of action.

It is therefore incontestable that aviation will have its uses along the coast line; but—and this is what I want to demonstrate—the creation of coastal stations is not necessary, because the operations of aeroplanes are so intimately bound with those of ships that the former ought to follow them throughout; as soon as the latter leave the coasts, coastal aviation loses its objective. Only the aeroplane on board ship is then necessary.

Besides, this is the naval view; because in the report to the President of the Republic, which accompanied the issue of the regulation of maritime aviation, it is only a question "of having the aircraft take part in offensive action of our naval forces."

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* *

The French navy has, in the past, made a serious mistake. She has pretended to encircle all of the seacoast of France, of Algeria, and of Tunis with hundreds of torpedo boats which ought to render access to the coast impossible. She has not succeeded, alas, except to ruin herself, and she has thus dropped from the second to the fifth place.

Do not let us make the same mistake with aeroplanes. We see in aviation a new element which can, in certain cases, facilitate maritime operations, but let us not allow the desire to give it importance to lead us to create useless things in its favor.

Let us make use of aviation. Let us not allow ourselves to be reduced to servitude by it.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

AMALGAMATION FEATURES OF THE PERSONNEL PROBLEM.

By LIEUTENANT COMMANDER HARRY E. YARNELL,
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AMALGAMATION.

There is at present[1] under consideration by the Naval Committee of the House of Representatives a personnel bill, which contains, among other provisions, one amalgamating the construction corps and the pay corps with the line of the navy.

Apparently simple to effect, it cannot but be admitted that such a measure may have far-reaching results on the efficiency of the commissioned personnel of the navy and should not be enacted into law until all the arguments for and against such a measure have been collected and most carefully considered.

The following extracts from Bill No. 26541, introduced in the House of Representatives on December 3, 1912, provide for the proposed amalgamation:

SECTION 14.—That the officers constituting the pay corps and the construction corps of the United States Navy be, and are hereby, transferred to the line of the navy, and shall be commissioned accordingly.

SECTION 15.—That said transfer to the line shall be made in the official order of precedence of officers at date of passage of this act, with rank according to such precedence in the line, or, in case loss of grade, or loss of rank in grade, would result, then to the grade in the line corresponding to such grade or rank in grade previous to said transfer, but in any case without change in the official order of precedence: *Provided*, That officers

[1] This article was originally written over a year ago. It has now been slightly changed and revised, dating from July 8, 1913.

In forwarding this paper to the Navy Department the commanding officer of the *New Jersey*, Captain F. K. Hill, U. S. Navy, says in his endorsement: "I cannot refrain from expressing the most hearty approval of this paper. So much has been written by officers who advocate this measure that it is time to call attention to some of the real facts in the case, and this paper gives real facts."

of said corps transferred to the line shall continue to rank with other officers of like grade or rank in the line or in any staff corps in accordance with the official order of precedence, in the same manner as before such transfer: *Provided, however,* That should any officer so transferred to the line have lost precedence on original appointment to the corps from which transferred, he shall, in future, while retaining his grade and present precedence, be entitled to the rank, pay, and allowances of line officers of his original precedence.

SECTION 16.—That any officer of the former pay corps or the former construction corps, after such transfer to the line, may, upon his own application at any time thereafter, be assigned temporarily to the general duties of the line, and if so assigned shall be given a reasonable opportunity to acquire the necessary experience in such line duties up to and including the duties of the grade he then holds, at the conclusion of which he shall be permanently available for such assignment if he passes the examination provided by law as preliminary to promotion to such grade, failure to pass not to displace such officer from the status for duty occupied by him prior to such temporary assignment: *Provided,* That should any officer so transferred to the line, and who shall have subsequently qualified for the general duties of the line, have lost precedence on original appointment to the corps from which transferred, he shall, after such qualification, resume his former order of precedence, with its corresponding grade and rank, subject to the examination required by law in case of promotion thereby to a higher grade.

SECTION 17.—That officers of the pay corps and the construction corps transferred to the line in accordance with this act, who shall not qualify for the general duties of the line in accordance with the preceding section, shall preserve their present status for duty, and shall have all necessary authority over officers and enlisted men for performing said duty: *Provided,* That assistant naval constructors of the rank of lieutenant (junior grade) so transferred shall be available for the general duties of the line.

SECTION 19.—That after the passage of this act the duties now performed by officers of the pay corps and the construction corps of the navy shall be performed by officers of the line who may be detailed for such duties: *Provided,* That no such detail be made of any officer of the present line who may be above the rank of lieutenant at the date of passage of this act, except temporarily in cases of emergency: *Provided further,* That sections thirteen hundred and eighty-three, thirteen hundred and eighty-four, and thirteen hundred and eighty-five, of the Revised Statutes be, and are hereby, repealed.

The arguments for amalgamation are contained in two pamphlets issued by the Navy Department: "Amalgamation of Pay Corps and Construction Corps with Line of the Navy," issued in 1912, and "Notes on Personnel Bill," issued in December, 1912; also hearings No. 25 before the Naval Committee of the House of Representatives in May, 1912. These pamphlets and

hearings are too extended to quote in full and the reader is referred to them for all arguments that have been advanced in favor of the amalgamation feature of the personnel bill.

Clausewitz, the great Prussian authority on military science, in one of his books said:

> There is, upon the whole, nothing more important in life than to find out the right point of view from which things should be looked at and judged of, and then to keep to that point; for we can only apprehend the mass of events in their unity from *one* standpoint, and it is only the keeping to one point of view that guards us from inconsistency.

When the above principle is applied to the reason for existence of a naval force and all that pertains to it, we can reach but one conclusion, which is almost axiomatic in simplicity, and that conclusion is that the naval force exists for the sole purpose of defense against aggression, and the upholding of our national honor. For the successful accomplishment of this purpose the naval force must be stronger in the aggregate in efficiency of material and skill of personnel than our probable opponent, when subjected to the great and final test of war.

Hence the test that must be applied to any proposed change of legislation affecting the naval establishment is, "Does it increase its efficiency for war?"

On page 1315 of the record of hearings No. 25, given before the Naval Committee of the House of Representatives, is found the following statement:

> The idea generally is this: That the officers after graduation should be selected according to their own inclinations *or in some other way* and then be given an additional course in their own specialty. After they had completed this special course they would then be available for the *general duties of a naval officer* and would also be available as a specialist, and when they were employed on their specialty in certain designated positions they would not be disturbed, but would be allowed to remain long enough to become thoroughly familiar with their work. (Writer's italics.)

From the above statement the impression is given to one not familiar with the naval service that the "*general duties of a naval officer*" consist of a few routine duties easily acquired at the Naval Academy or by a year or so of sea service, and that such duties are relatively unimportant compared with those of the various specialties in which officers are to become qualified. It is believed that this casual reference to and calm dismissal of the subject of the "general duties of a naval officer" is a grave

injustice to the naval profession; gives a wrong impression of the subject to legislators who are charged with the responsibility of passing the bill, and should not be allowed to go unchallenged by the line officers of the navy.

A consideration of the "general duties of a naval officer" leads one to the fact that these duties are the very essence of the naval profession, and that they are not duties which are easily acquired by a year or so of sea service in a lower grade, but require years of study and practice to become proficient in them.

The primary one of the "general duties of a naval officer" is believed to be a knowledge of the "art of naval warfare." If this is not true, then we must assume either that the navy is maintained for peace purposes only, or else that our corps of line officers is composed of supermen who will rely upon some indefinable and mysterious quality for victory over an opponent who has profited from study of the principles of war, and years of practice and experience in developing them as far as possible in time of peace.

We need not delve far in history to find numerous examples of the supreme necessity of keeping our personnel, and especially our commissioned personnel, thoroughly trained in correct principles of war.

The battle of Toulon, fought in 1744, between the British and French, is a striking illustration of what happens to naval officers whose minds have become rusty from disuse in primary duties. The following quotation is taken from Mahan's "Influence of Sea Power of History":

> The general inefficiency and wide-spread misbehavior of the English captains, after five years of declared war, will partly explain the failure of England to obtain from her undoubted naval superiority the results she might have expected in this war—the first act in a forty years' drama—and they give military officers a lesson on the necessity of having their minds prepared and stocked, by study of the conditions of war in their own day, if they would not be found unready and perhaps disgraced in the hour of battle.[2] It is not to be supposed that so many English seamen mis-

[2] There is not in modern naval history a more striking warning to the officers of every era than this battle of Toulon. Coming as it did after a generation of comparative naval inactivity, it tried men's reputations as by fire. The lesson, in the judgment of the author, is the danger of disgraceful failure to men who have neglected to keep themselves prepared, not only in knowledge of their profession, but in the sentiment of what war

behaved through so vulgar and rare a defect as mere cowardice; it was unpreparedness of mind and lack of military efficiency in the captains, combined with bad leadership on the part of the admiral, with a possible taint of ill will toward him as a rude and domineering superior, that caused this fiasco.

The example just given is one where a naval service was thrown into war after years of peace. Another example will be given of what may be done by an officer in high command after years of warfare.

During the Trafalgar campaign Admiral Sir William Cornwallis was in command of the blockade off Brest. He was a thoroughly trusted officer, of great tenacity, a fine seaman, and was given this command in 1803 as being the man most competent to carry out the rigorous blockade off Brest established by Lord St. Vincent. Yet when the supreme moment arrived for intelligent action he failed, and is known to history mainly for that failure. Mahan describes it as follows:

Such was the situation when, on August 17, Cornwallis was informed that Villeneuve had put to sea with, it was said, twenty-seven or twenty-eight ships-of-the-line. He at once detached toward Ferrol Sir Robert Calder with eighteen sail, keeping with himself sixteen. This division of his fleet, which is condemned by the simplest and most generally admitted principles of warfare, transferred to Villeneuve all the advantage of central position and superior force, and was stigmatized by Napoleon as a "glaring blunder." "What a chance," he wrote, upon hearing it when all was over, "has Villeneuve missed. He might, by coming upon Brest from a wide sweep to sea, have played hide and seek with Calder and fallen upon Cornwallis;

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requires. The average man is not a coward; but neither is he endowed by nature only with the rare faculty of seizing intuitively the proper course at a critical moment. He gains it, some more, some less, by experience or by reflection. If both have been lacking to him, indecision will follow; either from not knowing what to do, or from failure to realize that utter self-devotion of himself and his command are required. Of one of the captains cashiered it is said: "No man had ever lived with a fairer or more honorable character previous to the unfortunate event which did such irreparable injury to his reputation. Many of his contemporaries, men in the highest popular estimation, who knew him well, could scarcely credit what were indisputably established as facts, and declared, with the utmost astonishment, "they believed it next to impossible for Captain Burrish to behave otherwise than as a man of gallantry and intrepidity." He had been twenty-five years in service, and eleven afloat as a captain (Charnock's Biographia Navalis). Others of the condemned men bore fair characters; and even Richard Norris, who absconded to avoid trial, had been of respectable repute.

or else, with his thirty ships, have beaten Calder's twenty and gained a decided preponderance."[8] The censure of both admirals was just.

Luckily for England, Cornwallis' opponent was the more incompetent.

These examples may be multiplied many fold. The history of our Civil War on land is full of examples of the deplorable results of placing high command in the hands of incompetent generals.

It is not to be inferred that line officers of all grades must be equally prepared in military science. They cannot, like Longfellow's Indian, be born of an oak tree riven by lightning, springing forth with all of their weapons about them. The instruction must extend over their entire career; little at first, because a large part of the time is occupied with divisional and ship department duties. But always present, and in a gradually increasing scale, until by the time they have acquired command rank, our line officers will be competent to perform command duties in time of war.

The tendency to become steam-yacht sailors must be resisted. Professor Münsterberg of Harvard, in an article on Psychology of the Navy, states:

> The daily routine work may easily be carried on by officers and men who lack this belief, and the smoothness of their performance may deceive the world concerning the perfunctory character of their service. The interference with this ultimately decisive attitude may result from many conditions. Among the blue-jackets a great mental inhibition may come from the tendency to change the vocation. English observers seem to believe that here lies the central mental difficulty of the American navy, since it must be acknowledged that in no other country are the rank and file of the population so easily inclined to change from one vocation to another. The minds of the officers, on the other hand, are perhaps most easily harmed by what has often been called the spirit of the steam-yachtsman. The steam-yachtsman danger is, psychologically, especially grave, because it so easily creeps in without at first allowing any one to perceive the difference between the right and the wrong attitude. The steam-yachtsman loves the ship and its handling, enjoys the life on the water, is deeply interested in all naval movements; and yet the whole setting of his mind is fundamentally wrong for the officer who has to prepare himself and his men for the heroic work in the crisis. It is a spirit of ease and comfort, of charming hospitality and delightful companionship, of self-satisfied and good-natured sportsmanship. In many a foreign navy the true believers in sea power, therefore, dislike to see too many rich officers in the service, as their spirit of comfort and relaxation spreads far too much this steam-yachtsman attitude. There are not a few who believe that this difference alone was the

[8] Napoleon to Decrés, August 29, 1806.

real reason for the victory of the Japanese navy, in which such a steam-yachtsman element does not exist, over the Russian navy, in which it is said to be wide-spread.

At the present time have the command grades of the line personnel of the navy been trained in accepted methods of conducting naval war, and in accordance with the principles of the art? In time of war will the conduct of the fleet be in the hands of trained men or of supermen?

To obtain an unprejudiced estimate of our naval service, let us take that of a competent foreign civilian critic who has studied navies for many years. In a summary of several foreign navies, written in 1905, Mr. Fred T. Jane, the British critic, said, regarding our service:

> The United States Navy is in a somewhat different state, but its difference is of degree rather than aught else. The men have little to bind them to the service, and a man who is a blue-jacket this year may conceive that he had better be a dentist the next. The officers are mostly too old to have energy; they tend to be fond of ease and comfort and thoroughly self-satisfied. There are men among them distinctly otherwise. There are fine ships, but they do little war training. There is very little fitness to win to be perceived. Yet America is a young nation, and one takes it for granted that there is latent fitness sometimes unperceived. This may be; America at any rate rests confident that it is there.

This criticism can hardly be considered as flattering.

In the mass of testimony given before the Naval Committee there is no reference to this great and absolutely necessary qualification of a line officer; one which overshadows in importance all the favored specialties combined.

More than 50 years ago Von Moltke developed the German system of military training, which was soon placed to the test of two successful wars. His system was based on the training of all grades of officers in doctrine, intelligent initiative, co-ordination of effort, unity of action. Have we, with this example before us, taken advantage of it? After reading the essay on "Trained Initiative and Unity of Action," by Lieutenant Commander Knox, the answer must be in the negative.

Yet the adoption of this method costs nothing but *time and effort*, which the advocates of amalgamation propose to spend in purely routine designing, administrative, accountant, duties.

The art of seamanship is another branch of the "general duties" of a naval officer which is more important than the special-

ties of ordnance, engineering, and keeping of accounts; yet the word "seamanship" is lacking in one hundred pages of testimony. Seamanship is not acquired from books or at post graduate schools, but by years of actual experience at sea. Wind and weather, rocks, shoals, and the hazards of the sea, will exist until the end of time. The alertness and readiness in emergency of the sailing ship officer is fully as necessary to-day when vessels have reached a far greater size and speed. Can a position be imagined which requires more unerring judgment and quick decision in time of emergency than that of officer of the deck on a modern battleship. A wrong order or a moment of indecision may mean the loss of a large percentage of the national defense. Naval seamanship is more comprehensive than that of the merchant marine, in that it becomes involved with the tactics of battle. What are the effects of sun and wind on ourselves and the enemy? How can the battle approach best be made? What is the effect of sudden changes of course on our gun pointers? How avoid floating mines? How avoid enemy destroyers? How provide for or against fast wings? These are all questions of seamanship as well as of tactics. A search problem is one of seamanship. How far can we see the enemy, and how far can he see us, under varying weather conditions? What will each do in case of a fog? How much speed can each make in heavy weather, with and against the sea?

Questions of visibility of single ships and fleets in daytime and at night, under varying weather conditions, are questions of naval seamanship.

The above is but a meagre hint of what is comprised under the word "seamanship."

Yet it is proposed by the advocates of the bill to permit paymasters to qualify for line duties. If such is logical, then the Naval Academy is a useless expense and may well be abolished. But is it wise or practicable to produce a naval officer by cramming?

It can easily be imagined what comments the officials of merchant steamship lines would make to the proposal to amalgamate the deck officers and pursers. Yet the hazards of the sea are as great, if not more so, for men-of-war as for merchant vessels.

Another of the "general duties of a naval officer" is the ability to handle men. Everyone can recall cases of officers who excelled

in branches of their profession that required mentality, but were failures as naval officers, because they were "temperamentally unfit to command," they could not "handle men." The curriculum at the Naval Academy does not provide for this, and the newly made ensign in many cases is a burden instead of a help to his divisional officer on account of his ignorance of this important branch. Some are by nature better qualified than others to acquire it quickly, but it requires a number of years of actual experience in divisional work on board ship to develop it to the required extent. There must be firmness combined with justice, an understanding of the nature of the life, its pleasures and its hardships; and above all there must be a *thorough knowledge of the profession,* for enlisted men can never respect incompetent officers, or officers incompetent superiors, no matter how genial their other characteristics.

The whole subject of handling men and officers is closely allied with morale. In a paper on military character, Commander Schofield says:

> Over a century ago Napoleon said that in war the moral is to the physical as three to one. Since then there has scarcely been a military writer who has not quoted this remark of Napoleon and given it his approval. Military history teaches that in nearly every battle, character, morale, has been the determining factor. We accept the statement readily. But the remarkable fact is that, in spite of the known determining value of superior morale, of superior military character, and especially of the value of superior military character in those who command, no systematic and continued effort has been made in our service to examine the ways of creating superior morale, of creating a high average of military character in the service.
>
> We all know that loyalty, initiative, decision of character, poise, understanding, courage, boldness, perception, and justice are factors of character that we desire in the individuals of the service. But we think of these factors in a casual and desultory manner that seems to flow from a belief that such qualities are innate, that they cannot be built up through any system of effort.

Both Nelson and Napoleon owe much of their greatness to their ability to handle men. On this subject Mahan says in his comments on the battle of Toulon:

> Attention may here fitly be drawn to the effect of a certain cordiality and good-will on the part of superiors toward their subordinates. It is not perhaps essential to military success, but it undoubtedly contributes to the other elements of that success a spirit, a breath of life, which makes possible what would otherwise be impossible; which reaches heights of devotion and achievement that the strictest discipline, not so enkindled,

cannot attain. Doubtless it is a natural gift. The highest example of it possible ever known among seamen was Nelson. When he joined the fleet just before Trafalgar, the captains who gathered on board the flag-ship seemed to forget the rank of their admiral in their desire to testify their joy at meeting him. "This Nelson," wrote Captain Duff, who fell in the battle, "is so lovable and excellent a man, so kindly a leader, that we all wish to exceed his desires and anticipate his orders." He himself was conscious of this fascination and its value, when, writing of the battle of the Nile to Lord Howe, he said, "I had the happiness to command a band of brothers."

"There is a soul to an army," said General Sherman, "as well as to the individual man, and no general can accomplish the full work of his army unless he commands the soul of his men as well as their body and legs."

Colonel Wagner, in "Organization and Tactics," states:

The personal influence of the commander should be felt. He should be known by his troops and regarded as the impersonation, or at least the chief representative, of the cause for which the army is fighting. He should cultivate the morale of his troops as carefully as he provides for their food, clothing, and ammunition. In the Crimean War the British commanders (Lord Raglan and General Simpson) were, in this respect, all that a commander should *not* be. "During the siege of Sebastopol," says Wolseley, "I verily believe that a large proportion of our men did not know the name of the general officer commanding. They seldom saw him; he did not live amongst them. If he had feelings in common with them, they did not know of it. No touching appeals were made to their feelings of honor and patriotism. All our attention was bestowed on their stomach, and the result was we never got much out of our men, and that in August, 1855, our army was in a discreditable condition of demoralization.[4]

For the enforcement of discipline, in so far as the prevention and punishment of military crime is concerned, rules can be, and are, prescribed; but for that higher discipline which calls forth the supreme efforts of self-denial and daring—which, in fact, controls the soul of an army—there is no law of universal application; justice, kindness, firmness, earnestness, a solicitous regard for the physical welfare of the troops, an appreciation of what men can do and what is beyond their power, a deep knowledge of human nature, an understanding of the national characteristics, a visible willingness to share all the dangers and hardships to which the men are exposed, an appreciation of the special conditions under which the army is acting, and a thorough sympathy with the motives which inspire the best efforts of the soldier are requisite on the part of the commander. A knowledge of human nature is half of the science of war.

Connected with *morale* is the subject of *esprit de corps*. On page 1325, of hearings No. 25, before the Naval Committee, we find:

[4] Soldiers' Pocket-Book, p. 5.

There is this about the construction corps: I think sentiment plays a large part with them, and I don't blame them for it, and I don't see how you can avoid having a strong sentiment in that corps, because they have done magnificent work; they are men who are giving their whole life to that occupation, and of course abolishing the corps as an entity must hurt them, and the men who have taken the most interest in it are the men who would feel it the most. But that very thing points out to me this: That we don't want any entity in the naval service to which a man owes his first love; he owes it to the navy as a whole, and that furnishes its own argument.

If this spirit has contributed in the past to the present ability of the construction corps, what is gained by destroying it? And does not the same argument apply with equal force to the pay corps and the line? The pay corps is a thoroughly efficient body of officers, who have every reason to be proud of their past history. No one can examine the ponderous volumes of involved decisions of auditors and controllers, which must be consulted at every turn, or remember the hardships of countless cases of checkages, many of large amounts and extending over years, or realize the great advances that have been made in recent years in food, clothing, and all that pertains to a paymaster's duties, without a greatly increased respect for the pay corps. And than such arduous duties, when creditably performed, there are none more honorable.

The great improvement that has taken place in paymasters' supplies has been brought about through the undivided efforts of a corps of loyal and efficient officers, and the cases of breakdowns of paymasters from overwork show that it has been no easy task.

How will the efficiency of the pay corps be increased by dividing the time and interest of officers between two radically different duties. On page 1318, of the testimony, we read:

In fact the young paymasters could stand watch on board ship when they were also on duty as assistants in the pay department of the ship; while learning the duties of the paymaster they could also be standing watch, because their whole time would not be taken up in learing to keep accounts.

Does this lead to co-ordination of effort, unity of action? Decidedly not. One of the duties will suffer in proportion to the amount of interest taken in the other.

A similar case has already been tried in the fleet and found to be a failure. Officers were ordered to watch duty in the engine

room and also given charge of a deck division. This combination of duties is thoroughly unsatisfactory, and has been generally discontinued. Divided responsibility means divided interest, and results in lack of efficiency. It is not co-ordination of effort, or unity of action.

While the past history of the line does not merit the word "magnificent," yet it is to a certain extent creditable, and the writer, for one, takes pride in bearing the title and wearing the insignia that denote a line officer of the navy. When a renaissance takes place in the conception of what consititutes the intrinsic duties of a line officer and their relative importance; when we of the line can feel that we have trained ourselves to the limit for the purpose of carrying out the business for which we are maintained, less will be heard of the necessity of a knowledge of keeping accounts as a part of the training of those who are charged with the conduct of war.

AMALGAMATION OF LINE AND ENGINEER CORPS.

The alleged success of the amalgamation of the engineer corps with the line of the navy by the personnel bill of 1899 has been advanced as a strong argument in favor of the proposed amalgamation.

When an analysis is made of the personnel of the engineer corps and the duties with which they were charged, as compared with the personnel and duties of the pay corps, the argument disappears.

Above a certain date the officers of the engineer corps were not required to qualify for line duties, but were "for engineer duty only, and on shore only when of or above the grade of commander." They were given the rank and title of line officers, and as they accumulated in the captain and commander grades, the fact that they were not real captains and available for command duty afloat was used as an argument for making them "extra numbers."

All the engineer officers that were required to qualify for line duties were graduates of the Naval Academy and in some cases had had the same training as their classmates in the line for six years after entering the naval service. Their duties on board ship were purely military duties of maintaining machinery in

efficient condition, and in handling men. Furthermore, they were men whose minds had been trained to think quickly in cases of emergency. Accidents and casualties in engine and firerooms demand instant and correct action. So when these officers were transferred to deck duties they had had experience in handling men and machinery, were trained to act quickly in case of emergencies, and had had a certain amount of navigation and seamanship from their academy days. They were military men transferred from one line of duty to another. Unfortunately the bill did not require line officers to qualify in engineering duties, but there is no reason to believe that they would not have succeeded.

When this amalgamation is compared with one where the officers are, with a few solitary exceptions, from civil life, have had no military training, and whose duties are administrative and accountant, it is difficult to find a trace of resemblance.

While not pertinent to the subject, the success, or otherwise, of the amalgamation of the engineer corps and the line cannot be passed without comment.

The writer believes that the principle of amalgamation of the engineer corps and the line was correct, in that it combined two corps having similar military duties, and that the amalgamation of the pay corps and the line is incorrect in principle, since it combines two corps, one of which is charged with duties that are non-military. The line officer detailed for duty as paymaster might just as well be cashier of a bank in an inland state as far as any practice in military duties is concerned.

In order to decide whether the engineer amalgamation is an actual success, or otherwise, we must know whether the machinery of the navy is to-day in as efficient condition as it would be if the engineer corps had been maintained. Since this must remain unknown, the question remains open for various opinions. But it is known that our repair bills at the present time are very large. And it is also indisputable that machinery can be maintained in better condition by a permanent body of commissioned officers who have been trained in both the theory and practice of engineering, as were the officers of the old engineer corps, than by officers whose tour of duty in the engine room is limited and uncertain.

The present status of engineering in the navy is about as follows:

The engineer departments are administered with considerable efficiency by officers who have come into the service since the pas-

sage of the personnel bill of 1899, and who have spent a large percentage of their time in the service on engineering duty.

The duties of watch-standing and overhaul that were performed by the commissioned officers of the old engineer corps are now performed by warrant machinists.

The commissioned officers on duty in the engineer department are usually there for instruction and their tour of duty is too uncertain to render them of much assistance to the senior engineer, who naturally prefers to rely on his permanent staff of warrant officers who are "for engineering duties only."

There are ships where commissioned officers are assigned for sufficiently long periods to enable them to be given responsible duties, but such ships are the exception.

It is left to the reader to judge whether the system as at present administered is a success or otherwise; reference should also be made to the annual reports of Engineers-in-Chief Melville and Rae as to their views of the practical success of the amalgamation a few years after the passage of the bill. Their just complaints were based on the fact that most of the engineer officers were taken for deck duties and none were sent to replace them. It was a very natural result of the "flexibility" which is said to be one of the advantages of amalgamation.

The great demand for officers to man batteries and the complicated fire control systems has rendered few available for engineering duties, and the bulk of the work falls on the 224 machinists now on the navy list.

The whole subject of amalgamation is one of adjustment, just as is the design of a battleship; but for both, the line of the navy and the battleship, *fighting efficiency* must predominate.

We can extend amalgamation to a certain point, but if it exceeds its appropriate limits, stern necessity forces it back.

At one time in the navy we attempted to teach every member of the deck force signals and wig-wag. This method was satisfactory as long as ships cruised singly and there were no signals to send; but when squadrons were formed and skill in signalling became necessary, this was found to be impracticable, and now we have a corps of *specialists* in signals.

A short time ago our radio operators were required to take a regular tour of duty in the dynamo room in order to make them all-around electricians. After the *Titanic* disaster, and some un-

pleasant recriminations between naval and commercial operators as to each other's ability, it was decided to make our radio operators permanent for that duty. The results have been most gratifying with our present specialist corps of radio operators. Competition forced us to become specialists.

One of the most difficult problems on board our ships to-day is that of mess-cooks. These are detailed in rotation from the divisions to serve as such for a certain length of time. The result is most unsatisfactory, and it is only a matter of time when this work will be done by a permanent corps of messmen.

When we come to the military specialties that concern line officers, such as ordnance, engineering, and electricity, there is of course no objection to the line officer being a specialist in these branches if he so elects, and if it does not interfere with his being, primarily, *a specialist in the knowledge of the use of his instruments, in the art of war.*

But when the designing specialist predominates and the *line specialist* is relegated to the background, then that officer ceases to be of the line and should belong to the specialist branch which he has selected.

It is not to be inferred that when an officer becomes a material specialist his sea service ends. An ordnance specialist can build better guns, and a naval constructor better ships, and the engine designer better engines, if a proportion of his time is spent at sea in actual contact with the instruments for whose construction he is responsible. But this time at sea must necessarily be less than that spent on shore in the actual work of designing and construction.

Neither is it to be inferred that the *line specialist* must spend all of his time at sea. Alternate periods of sea and shore duty must take place to offer a change from the exacting requirements of sea life, and to perform such duties on shore as can be done only by line officers.

The postgraduate schools at present established in engineering and ordnance are excellent shore duty for line officers of the grade of lieutenant. All officers, if practicable, should pass through a course at the War College some time between the ages of thirty-five and forty-five. But for line officers, the sea duty must predominate.

It may be of assistance to a line officer to know the details of the manufacture of his instruments, but it is not necessary. He is concerned with their employment, which is the greatest specialty of them all, and for a mention of which we may search in vain through long pages of Congressional testimony. We find references to navy-yards, planning departments, accounting, scientific management; we find proposals to send line officers to navy-yards to work on lathes; but we find nothing regarding the use of the finished instrument.

Guns, engines, dynamos, and ships can be and are being designed most successfully by civilians who devote their entire time to their one specialty.

But there are no civilians who can conduct naval war. That is a specialty which falls upon the line of the navy alone. So it is well to be ready when that time comes, and not squander our energies along lines which can be done as well or better by others.

Rather let us burn deep in our minds the words of Mahan:

> I will sound again the note of warning against that plausible cry of the day which finds all progress in material advance, disregarding that noblest sphere in which the mind and heart of man, in which all that is god-like in man, reign supreme; and against that temper which looks not to the man, but to his armor. And, indeed, gentlemen of the navy, if you be called upon some day to do battle, it will be for the country to see that your weapons are fit and your force respectable; but upon your own selves, under God, must you rely to do the best with the means committed to your charge. For that discharge you will be responsible, not to the country only, but to your own conscience; which will condemn you if, in the eager curiosity to know how your weapons are manufactured, you have neglected to prepare yourself for their use in war.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE REPAIR AND ALTERATION OF SHIPS AS PROVIDED FOR IN THE NAVAL INSTRUCTIONS.

By LIEUT. COMMANDER T. A. KEARNEY, U. S. Navy.

It will facilitate the understanding of the naval instructions relative to the accomplishment of repairs and alterations to ships if we examine into the causes contributory to their being and the objects sought to be attained through their operation. Perhaps it will be argued by the busy officer that these features are extraneous—that all he wants are results; such arguments are neither here nor there. Results that are to be dependable—that are to closely approximate our designs, plans and estimates—are not the offspring of chance or hazard.

Admittedly it would be an ideal condition and the very embodiment of simplicity if the repairs and alterations required from time to time by the vessels of the navy could be accomplished by a single copy request carrying with it the assurances of subsequent approval, authorization and accomplishment.

Naturally this ideal condition cannot be attained. However, it is confidently believed that the requirements and provisions of the system outlined in the 1913 naval instructions, under the title Repairs and Alterations to Ships, possess more attributes of the ideal than any previous attempt in this line; and the study of this particular chapter is recommended as a matter of the utmost importance to those officers charged with the responsibility for the material readiness of our ships.

The chapter in question is a composite of many ideas, harmoniously blended to meet the exacting requirements of existing laws, departmental and bureau practices, navy yard industrial organization, and the best interests of the service as a whole.

It was found in the course of compilation that obligations and recommendations were in some instances more or less antagonis-

tic—in many cases wholly in opposition, but now that the work has been completed and the system stands forth as an actual working, accomplished fact, there is every reason for asserting that the new instructions possess the essential elements of directness and simplicity; that they fulfill the requirements of the law; and that with even casual study they will be acceptable and satisfactory to the personnel interested in their operation.

The following governing conditions were recognized as being essential to and are incorporated in the new instructions:

(a) Compliance with the laws and regulations relating to expenditures, limitations, accountability and cognizance.

(b) Simplicity of methods; the elimination of unnecessary paper work; the proper routing of papers; and the promptness of final action thereon, with the resultant promptness in the completion of authorized work.

(c) The integrity and completeness of necessary files and records.

(d) The adoption of a standard of procedure, having the fewest possible number of exceptions incident to the execution of its various details.

Congress provides annually for the naval service in what is known as the Naval Appropriation Act. Through the medium of this act certain sums are provided each fiscal year. These sums are grouped under various subheads, referred to as "appropriations," and bear a certain relation to estimates previously submitted by the department in anticipation of its probable needs. Enumerated under each subhead are the various purposes for which the money therein provided may be used.

The responsibility for the proper expenditure and accountability of these several funds is vested in the Secretary of the Navy and the chiefs of bureaus of the Navy Department.

In providing the funds above referred to, Congress has seen fit to enact certain restrictive legislation relative to their expenditure; these restrictive clauses are generally known in the Navy Department as the *Statutory Limits,* and are as follows:

Provided: That no part of this sum shall be applied to the repair of any wooden ship, when the estimated cost of such repairs, to be appraised by a competent board of naval officers, shall exceed *ten per centum* of the estimated cost, appraised in like manner, of a new ship of the same size and like material.

Provided further: That no part of this sum shall be applied to the repair of *any other ship* when the estimated cost of such repairs, to be appraised by a competent board of naval officers, shall exceed *twenty per centum* of the estimated cost, appraised in like manner, of a new ship of the same size and like material.

Provided: That nothing herein contained shall deprive the Secretary of the Navy of the authority to order repairs of ships damaged in foreign waters or on the high seas, so far as may be necessary to bring them home.

And provided further: That the Secretary of the Navy shall hereafter report to Congress at the commencement of each regular session the number of vessels and their names upon which any repairs or changes are proposed which in any case shall amount to more than two hundred thousand dollars, the extent of such proposed repairs or changes; and the amounts estimated to be needed for the same in each vessel; and expenditures for such repairs or changes so limited shall be made only after appropriations in detail are provided for by Congress.

With this insight into the manner in which funds are provided, it is essential that we next examine into the methods of disbursement, and study the broad principles of departmental organization.

To facilitate the transaction of the business of the Navy Department its activities have been grouped in four grand divisions: Operations, Material, Personnel, and Inspections.

It will suffice in this instance if we understand the composition of the material division, and the results sought to be attained through it and the division of inspections.

The Division of Material is composed of the Bureaus of Construction and Repair, Steam Engineering, Ordnance, Supplies and Accounts, Yards and Docks, Equipment, and the Office of the Director of Navy Yards, and is in direct communication with both the Secretary and the Assistant Secretary through its various Bureau Chiefs and the Aid for Material. From its composition and the nature of its activities it follows that the details of all material work, whether ashore or afloat, the procurement of supplies, and the industrial organization of the navy are centralized in this division and are under the cognizance of its several bureaus.

The responsibility for the design, construction, repair and material maintenance of vessels of the navy is essentially a function of the Bureaus of Construction and Repair, Steam Engineering, Ordnance, Supplies and Accounts and Equipment (the duties of this last named bureau being at present distributed among the Bureaus of Construction and Repair, Steam Engineering, Sup-

plies and Accounts, and Navigation); and while the lines of demarcation, the beginning and ending of individual bureau cognizance, may in certain cases seem vague and indeterminate, yet as a rule they are susceptible of ready understanding, are clearly defined and are a matter of record. Each bureau chief is the technical adviser of the secretary in all matters under his particular cognizance.

The administrative offices of the material division are located in the Navy Department, Washington, D. C.; its industrial activities permeate the entire navy, ashore and afloat.

The industrial navy yards are successfully and economically operating under an organization that may be graphically shown as follows:

Commandant (Manager)
- Manufacturing department
  - Hull division.
  - Engineering division.
- Public works department.
- Inspection department.
- General store-keeping department.
- Pay department.
- Accounting department.
- Medical department.

(See Chapter 36, Navy Regulations.)

At the head of each of the yard departments is an officer of the line or staff corps of the navy, depending upon the work to be done by that particular department, who acts as the agent of the commandant in carrying out the work assigned and authorized by the several bureaus. The regulations provide that whenever any work is to be performed at a navy yard the commandant is to direct its performance by either the machinery or hull division of the manufacturing department, or by the public works department, according to the nature of the shops and resources which may be required therefor, and it is done under the supervision and control of the head of division or department to which it has been assigned.

Having thus shown the various units of our organization it remains but to study its operation as a whole, or, speaking figuratively, we may now start the machinery and follow the grain through the mill.

Yard activities are dependent upon the amount of money that is allotted to the yard either monthly, or from time to time, by

the bureaus; and these allotments are in turn dependent upon the unobligated bureau balances and the estimate of amounts required as submitted by the commandants.

The work that comes to the yard in so far as pertains to vessels of the navy may be subdivided into two grand classes:

(1) New construction, ranging in magnitude from the building of a complete battleship to the manufacture of any of the many articles required for the naval service.

(2) Repairs and alterations to vessels already completed, which may vary in amount from a small urgent repair job to a thorough overhauling.

Taking into account the facilities possessed by the several navy yards and naval stations, and having due regard for the demands of the fleet and the desirability of maintaining a uniform labor roll, the Navy Department, by general order, has assigned all vessels of the navy to certain designated home yards, and has assembled at such yards the accessories, spare parts, patterns and working plans of the vessels based thereon.

In so far as has been possible, the department has also adopted a schedule of docking and repair periods; battleships being docked semi-annually and overhauled every fifteen months; destroyers docked semi-annually and overhauled by groups twice each year; submarines follow the same routine, generally speaking, as do the destroyers; auxiliaries and vessels on detached service are repaired, docked and overhauled as conditions demand and circumstances permit.

It follows then that the work on ships at navy yards, under the designation of repairs and alterations, permits of the following simple classification:

(1) Emergency work; urgent repairs.
(2) Docking and routine docking work.
(3) Overhaul.

In order to clearly differentiate between repairs and alterations the department, in accordance with the recommendations of the technical bureaus, has adopted the following definitions limiting the meaning and scope of the words in question:

Repairs shall be construed to mean such work as may be necessary to restore the ship or article under consideration to serviceable condition, without any alteration in design, without the addition of any article or parts, and without the removal of any article or parts that are not to be replaced.

This class of work is further subdivided into:

(a) *Urgent repairs,* which shall include all immediate repairs necessary for cruising or military efficiency, for the prevention of deterioration, or for sanitary reasons.

(b) *Desirable repairs,* which shall include all repairs which it is desirable to have made when the services of the ship can be spared for a length of time sufficient to accomplish the work.

The word *alterations* shall be construed to mean all work not included in the definition of "repairs" as quoted above; and shall include all changes in design that may be deemed advisable in making repairs; it shall also include all additions of any articles or parts and the removal of any articles or parts that are not replaced by similar ones. It shall include all changes in the character of the material of which any article or part is made.

It is essential that these definitions be clearly understood and closely followed, for upon them the frame work of the instructions are builded.

It is the intent of the new instructions that the ship's officers shall be capable of differentiating between *urgent repairs, desirable repairs* and *alterations;* further, that they shall be able to segregate the various items in accordance with bureau cognizance. It is of particular importance that the items of requested work be clearly and definitely stated.

All requests, irrespective of the nature of the work required, are made out in triplicate, in accordance with a standard form, equally applicable to either urgent repairs, desirable repairs, or alterations (see Articles 4331 and 4333).

These three classes of requests do not, however, follow an identical routing, nor would the same request follow the same channels in every instance. The exceptions are clearly set forth under the paragraph dealing with the subject, "Forwarding of requests."

Generally speaking, urgent repair requests are so routed as to insure their prompt consideration and approval, it being recognized that this class of work must be done with the least possible delay. Alterations, on the other hand, require much more consideration, the development of new designs and the analysis of their effects not only on the ship in question, but upon all vessels of the same class.

Urgent repair requests are submitted to and immediately acted upon by the commandant and work is started on such items as he considers necessary, provided the same can be done within the statutory limit of cost, without exceeding the allotment of

his funds, and by the date set by the department for the completion of work on the vessel. So far as the authorization of urgent repairs is concerned, the commandant shall be the judge of the urgency of each item of repairs requested and the fact that the commanding officer of a ship has included any particular item in the urgent list does not of itself authorize the commandant to proceed with the work unless in his judgment the urgency actually exists. (See Articles 4335 (5a) and (11)).

Should the commandant be of opinion that the work requested is not an urgent repair item, the ship's request together with an estimate of time, cost and his recommendation endorsed thereon is forwarded to the appropriate bureau for final action. (Art. 4335(b)).

The procedure outlined in the two preceding paragraphs authorizes the commandants to undertake, without reference to the bureaus or the department, the work required in the vast majority of urgent repair requests, subject only to the provisos that the ship and funds are available for the accomplishment of the work.

Desirable repairs refer to a class of work that is not urgent in nature; work which can be deferred; possibly disappoved; and very probably be merged into an alteration, without material disadvantage to the ship submitting the request for same.

These conditions warranted a slight change in the routing of desirable repair requests from that followed by an urgent repair request, and in consequence requests for desirable repairs and for alterations require bureau consideration before authorization.

Such procedure is especially imperative in the case of alterations involving as they do considerable expenditures and the possible incorporation of ideas that have been tried out and abandoned for some technical or professional reason.

When work has been authorized, its accomplishment and follow-up rest entirely with the yard and the ship's inspecting officers. In this connection attention is invited to the instructions relative to the direction and responsibility of work (Article 4341).

As soon as an item of work has been authorized, either by the commandant, bureau or department, the same is incorporated by the commandant in the *weekly report of work*, a complete copy of which is sent each week to the commanding officer of the vessel undergoing repairs; partial copies being forwarded to each bureau concerned.

These reports contain in a compact form the following information:

(a) The yard division in which the work is being done.

(b) The appropriation to which the work is charged.

(c) The number of the job order, date and source of authorization, together with the wording of the job order or a brief thereof.

(d) The estimated cost of the work under the division of labor, material and indirect charges, and the estimated total of working days required to do the work.

(e) The number of working days required to complete the work, supplemented by any pertinent remarks explanatory of delays or unusual conditions.

A familiarity with these reports will be found to be of the greatest assistance to the ship's officers.

In addition to the weekly report of work, referred to in the preceding paragraphs, commandants prepare and submit to the department and the bureaus a "summary of the weekly reports of work," containing in brief the following information:

(a) The names of all vessels at the yard, whether belonging to the navy or other departments of the government, upon which work is in progress; the total number of days work authorized under the cognizance of each bureau; the probable date of completion of all work and the date of readiness of each individual vessel for sea.

(b) A similar list for vessels based on the yard, or scheduled to repair thereat, but absent therefrom at the time the report was written.

These summaries are of especial value to the department inasmuch as they are in part indicative of the actual and prospective work at the various yards, and the date of a vessel's readiness for sea.

II.

DOCKING.

Docking and routine docking work becomes a separate and distinct class of work if undertaken during a scheduled semi-annual docking period.

At such times the work must be carried through with the least possible delay so as to permit of docking the remaining vessels of the division or group, during the period. The ship's bottom is cleaned and painted; the underwater surfaces of the hull, together with valves, fittings, zincs, and propellers are examined and overhauled as required.

If the docking be undertaken during an overhaul period, or with a view to repairing any damage to the underwater body of the vessel, the stay in dock is for a much longer period, and major items of work, including the cleaning and painting of the double bottom compartments and the rewooding of shaft bearings, are proceeded with.

It frequently happens that emergencies arise requiring the immediate docking of naval vessels, vessels belonging to other departments of the government, or vessels of the merchant marine. In order that the department may make prompt decision in such cases, the Bureau of Construction and Repair has been specifically charged with the duty of keeping an accurate record of the activities of all dry docks, and in particular with reference to their occupancy or availability. For obvious reasons authorization to dock a vessel must be obtained from that bureau. (See Art. 4342.)

III.

OVERHAUL.

The preceding remarks under both sections, I and II, of this article may be considered as explanatory of that class of work requiring no extended time or considerable expenditure of funds for its accomplishment.

The procedure in the case of a general overhaul of a vessel, or the undertaking of extensive repairs amounting in some instances to the practical rebuilding of the ship, while different from that followed in the cases just described, is equally simple and direct once the scheme is understood.

Taken in its integral parts and viewed sequentially, we find the predominant features of the system to be:

(1) Conditions which predicate the necessity or desirability of an overhaul (Art. 4305).

(2) An inspection for the purpose of ascertaining the material condition of the vessel; the amount of work required; and to consider the advisability of proceeding with an overhaul.

(3) The preparation of plans and estimates of costs.

(4) The consideration by the bureaus of the various items of work and the final action of the department, based upon the bureaus' recommendations.

(5) The authorization and accomplishment of the work.

The program followed in connection with the scheduled overhaul of the battleships of the Atlantic fleet is an excellent example of the methods employed in the accomplishment of the class of work now under consideration.

At a time from three to six months in advance of the date determined upon for the beginning of the overhaul, and if practicable while the vessel is at her home yard, the Department directs that an inspection be made in all departments of the designated vessel, with a view to ascertaining her material condition and for the purpose of obtaining comment and recommendation relative to such work as may be considered necessary to place the vessel in a satisfactory condition, either for the continuation of her present duties or to fit her for some designated service. (Art. 4308(a).)

This inspection, known as the material inspection, is made by the Board of Inspection and Survey for Ships, augmented by representatives from the hull and machinery divisions of the yard manufacturing department. The object in placing these additional members on the board is to facilitate the subsequent preparation of estimates of the cost of contemplated work.

The Board of Inspection and Survey for Ships is one of the component parts of the Division of Inspections of the Navy Department. This board is more or less permanent in its membership and is composed of officers skilled in engineering, construction, ordnance, and conversant through actual experience with the sea-going requirements of the navy. Being separate and distinct from the material division, and in no way affiliated with the Bureaus of that division, its criticisms, recommendations and findings are accepted as being impartial and without prejudice by all concerned.

In addition to a thorough physical inspection of the vessel, the board considers the various repair and alteration requests that may have been submitted subsequent to the last general overhaul and upon which no work has been done, data for this purpose being obtained from the commanding officer of the vessel, the commandant and the bureaus. (See Article 4311.)

Copies of the board's report are sent to the commanding officer of the vessel, the commandant of the navy yard, and the bureaus, the original of the report going to the Navy Department (Division of Material). The commandant, immediately after the receipt

of the yard copy, proceeds without further orders with the preparation of estimates, omitting the estimates for such items of work as may not have been recommended by the board, unless the same be specially called for by the bureaus. In this connection it may be of interest to note that the Revised Statutes, Sections 1538 and 1539, define the composition and membership of the Board of Estimates for work chargeable to the appropriation "construction and repair" and "equipment of vessels (C&R)," should the amounts be in excess of $3000 and $1000, respectively.

The reports of estimates are forwarded to the bureaus concerned and by the bureau endorsed with appropriate comment and recommendation to the department (Division of Material).

The yard in the meantime, through the heads of its manufacturing department, has proceeded with a careful revision of its schedules of material in order that appropriate requisitions may be started on their course immediately after the order to proceed with the overhaul is received.

The procurement of material is a source of considerable delay. What with the detailed preparation of technical specifications and requisitions; advertisement for the purpose of procuring competition; the opening of bids and the award of contract; and the inspections during process of fabrication, several months may easily elapse between the date of original request and that of final accepted delivery.

When the several reports of estimates with the accompanying bureau recommendations are received in the department it becomes necessary to consider:

(1) Whether the military value of the vessel in question is such as to warrant an expenditure incident to an overhaul.

(2) Whether the overhaul for purpose of continuation of present services, or for assignment to some other class of service, is in accordance with departmental policy.

Should these questions be decided in the affirmative and the total of the estimated costs under all bureaus be within the statutory limit, then the department indicates by endorsement what work shall or shall not be undertaken, summarizes the authorized expenditures under all appropriations, announces the statutory limit, and fixes a date for the completion of the overhaul.

The general authorization having been obtained, the detailed instructions, relative to the various items of approved work, are issued to the commandant by the bureau having cognizance.

In this, the same as in the case of individual items of repairs or alterations, the responsibility for the accuracy of plans and the issue of detailed instructions are functions of the bureaus.

Provision is made in the instructions for an appeal for reconsideration of a request for alterations previously disapproved.

Work on ships in full commission is given precedence over all other work, and whenever practicable, material is assembled and work is authorized prior to the arrival of a vessel at a yard.

In conclusion, I can but renew my previous assurances that the system is neither a thing of mystery nor of many complications; its understanding follows from a careful reading; its details are susceptible of easy mastery.

The efficacy of the system, and the accuracy of its details are best attested by the fact that it has required no changes or corrections since placed in operation.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SCOUTING AND SCREENING OPERATIONS.

By LIEUTENANT W. S. PYE, U. S. Navy.

The rapid progress of diplomatic actions, made possible by the cable, makes the probable period of strained relations between nations of short duration.

The preparation of the fleet, commissioning ships, establishing the train, etc., that is to say, mobilizing, will fully occupy such period.

There is no time after war is probable to study theory or to test the practicability of methods of using the various types of ships.

This is particularly true of scouting and screening operations, for these are the first operations and continue until the end. Upon the successful performance of these duties may rest the fate of the nation.

The reconnoitering forces will generally be under the direct control of the commander-in-chief, for he alone can give them such instructions as will best aid him in accomplishing the end in view.

In such an important service, coordination of effort is imperative, and the commander-in-chief should give the necessary instructions to ensure cooperation. The amount of detail contained in the instructions to the reconnoitering forces will vary with the conditions and the difficulty that may be encountered in coordinating their operations.

In order that these instructions may be reduced to a minimum we must use a common nomenclature for types of operations. We must understand and have names for common methods of procedure. These methods, based upon theory and past experience,[1] "will prevent errors, omissions and negligence."

[1] Bernhardi.

It must always be remembered that "the most perfect reconnaissance is of no value if the report is not received in time."[1] Information to be of value must be recent and *accurate*.

We must be prepared, when war breaks out, to proceed on scouting and screening service with faith in our common knowledge of its necessities and possibilities.

We have no war service to guide us and little experience gained from actual scouting operations in maneuvers. We must, therefore, turn to the chart maneuvers for guidance.

Having mastered the theory we must depend upon peace maneuvers on a large scale to test the practicability of theoretical methods.

Transmission of information is one of the greatest elements of successful scouting and every endeavor should be made to determine ranges and rates of transmission by radio.

TYPES OF NAVAL CAMPAIGNS.

The end in view in naval warfare should be the destruction of the enemy's naval force. Clausewitz' universally accepted doctrine of war[2] "was based on the principle that the destruction of the enemy's main army is the one true goal of all warlike effort, and that it is to be brought about by the application of superior force, at the decisive point, at the decisive time."

To most naval men, seeking the enemy to destroy him appears to be the normal line of action, and yet in only one war since the battle of Lepanto in 1571 has this been the guiding principle of the naval operations of both belligerents.

In many cases this has not come about so much through disparity of forces as through failure to abstain from minor operations, the value of which was insignificant in deciding the war.

The aim of every naval commander should be to engage the enemy on terms favorable to himself, but this desire to gain an advantage has often caused a false attitude with respect to fighting and furnished weak minds with an excuse for minor operations, the anticipated value of which must have been looked at through magnifying glasses.

[1] Bernhardi.

[2] Edinburgh Review, April 1911, page 327.

As has been said, only one war, the third Dutch-English war, furnishes an example of both belligerent nations exerting all their naval energy to crush the naval force of the enemy.

Destroying the main force of the enemy, the idea so long the guiding principle of land warfare, has become recognized as proper for naval warfare and in the future will undoubtedly be the controlling principle.

The adoption of this principle does not necessarily imply that each fleet is to immediately seek battle no matter how unequal the forces. It merely implies that all naval energy should be exerted to create a favorable opportunity for engaging the enemy, and not frittered away in operations, the value of which in deciding the war, will be negligible.

In case of war between two powers situated so close to one another that both naval forces can act freely in the theater of operations without a train, if the forces are approximately equal, we might expect that both fleets would put to sea with the idea of testing their strength in a decisive battle.

The attack by the Japanese destroyers at Port Arthur before the declaration of war is, however, the most likely example of the commencement of hostilities.

The days of chivalry in war are past. The sacrifices made in order to assure preparation must not be wasted. To defeat the enemy fleet is not enough. It must be annihilated. A slight preponderance of strength at the commencement of a battle will eventually become great.

In these days of steam, pursuit is not so difficult as in the sail era. Up to the present all naval battles under steam, with the exception of the reckless retreats of the Italians at Lissa, Russians on August 10, and Turks in the recent war, have ended with the practical annihilation of one force.

Naval strength cannot be measured solely by numbers of ships, of guns and weight of armor. The morale, and the preparation of the fleet for war, are still the dominating factors.

Assuming that each of the belligerent fleets remains intact until the declaration of war, it is reasonable to suppose that the fleets, if approximately equal in force, will seek each other to engage in a decisive action.

What then will be the duties of the reconnoitering forces? To prevent surprise? To gain information of the approach of

the enemy in time to enable one's own fleet to assume a battle formation before meeting the enemy?

Yes, both of these are duties and many such examples can be found in history. But there is a previous duty.

In considering this duty we pass from history to theory; to the era of torpedoes, floating mines and steam propulsion.

Before the torpedo era, daylight and darkness were equally favorable or unfavorable to each belligerent fleet, but to-day daylight favors the naval force superior in capital ships and submarines, while darkness favors the force superior in destroyers and mine layers.

As we are assuming for the present that the belligerent fleets are approximately equal, it is probable that each fleet will endeavor to decrease its opponent's day strength by a night attack by destroyers and mine layers.

Destroyers to be effective must act in numbers. Their radius of action at high speed is small. If we separate them to find the enemy we may not be able to concentrate them to attack in force. If we use their fuel in an unsuccessful search, we may be without them at the desired moment. The destroyers must be led to their prey.

Who will lead them? The reconnoitering forces. What force of the enemy will attempt to prevent our reconnoitering forces gaining the necessary information? The reconnoitering forces of the enemy.

This shows the value of the reconnoitering forces, which is too seldom taken into account. Their first duty is to seek out the enemy in order that their destroyers may act to the best advantage in reducing the enemy's daylight strength. Their second duty, the protection of the main force from observation by the enemy.

In order to gain a decided advantage over the enemy, the reconnoitering forces must be successful in each duty. The two duties are distinct.

General Bernhardi says, "For however important it may be to gain early information of the enemy, it is naturally just as important to deprive him of this advantage." This saying was made with regard to land warfare but it is equally true with regard to naval warfare.

With modern speeds, fleets approach rapidly and, in order to gain the advantage of a destroyer night attack, the enemy must

be located at some distance, while similar information of our main force must be denied to him.

In this phase of naval warfare, both fleets approaching with the intention of engaging, considered normal but seldom so found in practice, we recognize two lines of effort of the reconnoitering forces. Scouting, operations to gain information for offensive action. Screening, operations to deny similar information to the enemy.

A second general form of operations: Oversea expeditions with an immediate mission of arriving at, or seizing an advanced base, is a result of steam propulsion.

Oversea expeditions of one hundred years ago could be undertaken without the many difficulties of supply that now beset a naval force.

In an account of Nelson's chase after Villeneuve to the West Indies, we read that he took on five months provisions before leaving Europe and, with the exception of water, received practically no stores until his return to Europe.

In these days of steam such a cruise would require a well equipped base in the West Indies or an enormous train of colliers and supply ships. Strict neutrality and the necessity for coal have greatly reduced the time during which a ship can remain self-sustaining.

This factor, necessity for supplies, affects naval campaigns in a much different manner than it affects land warfare. The naval force is accompanied by non-combatant ships carrying supplies. The land force receives its supplies by constant transportation over the lines of communication.

In land warfare two contending armies of approximately equal strength approach each other with the idea of fighting at the earliest possible favorable moment. They are in a state of equilibrium until one commander, through information received concerning the opposing force, decides to assume the offensive. The principal factors in making the decision are: composition of enemy forces; relative positions of the force as regards terrain; relative location of the two forces with regard to their respective lines of communication; relative states of efficiency and morale.

An army acting on the strategic offensive will almost surely act on the tactical offensive also. An advance into an enemy's territory necessitates a longer line of communication with the

attendant difficulties of supply and of reduction in force, caused by the necessity to guard this line. Seldom can an army benefit itself by avoiding the enemy during such an advance. Knowledge of the location of the enemy force is a necessity, for otherwise the enemy might cut the line of communication with ease.

In land warfare information of the enemy's location is absolutely necessary. Such information will be determined by reconnoitering parties from the independent cavalry. The two opposing cavalry forces are almost sure to meet with the result that the weaker will be seriously handicapped in gaining information.

In naval warfare a fleet making an oversea passage will usually find it necessary to carry its provisions in accompanying ships. The *immediate* line of communication is the line between the train and the main body, which, in most cases, will be so short as to be negligible.

The location of the enemy main body, some distance on its flank, is no immediate menace to such a naval force.

This is one great difference between land and naval warfare and it is because of this difference that the location of the enemy force is, in naval warfare, less of an immediate necessity to the force acting upon the strategic offensive than it is to an army so acting.

The disadvantage of carrying provisions in a train is felt by the serious handicap of guarding such a large assemblage of vulnerable ships, and in the reduction in mobility occasioned by numerous slow moving, indifferently handled auxiliaries.

Although the line of communication practically does not exist during the *passage* of a naval force through the theater of operations, the difficulties of guarding one's provisions *during a battle,* in the presence of a train, is much more serious in naval warfare than is the guarding of the line of communication during battle, in land warfare. An army can retreat upon its line of communication; a naval force may be unable to retreat if its train is destroyed.

This tactical handicap imposes upon the fleet making an oversea passage, the necessity of acquiring an advanced base in which the train may be deposited in safety before joining battle. To the force accompanied by a train, evasion, or at least denying information to the enemy, becomes of first importance.

In view of the great distance that separates the United States

from any probable enemy, this form of campaign will almost surely be found in any future war in which we may engage.

As the fleet accompanied by a train is at a great tactical disadvantage, the opposing fleet must endeavor to bring it to action in the presence of its train.

Again are seen two distinct lines of effort of the reconnoitering forces: Scouting; operations to locate the enemy and furnish information for offensive action. Screening; operations to deny information or to destroy or deceive the enemy's reconnoitering force, in order to aid the main body in evasion.

It must be understood that a force accompanied by a train is not necessarily limited to defensive operations. The relative strengths of the forces may make the handicap of the train inconsiderable. Under normal conditions, however, the main force of the fleet accompanied by a train, will only take the tactical offensive when evasion is no longer possible.

From the nature of the operations just described, it appears that there are two normal types of operations for a fleet: (1) Operations with the primary mission of engaging the enemy main force at the earliest possible favorable moment. (2) Operations with the primary mission of reaching a geographical objective before engaging the enemy.

Certainty of success in the first type requires early and almost constant information of the enemy. The reconnoiternig force of a fleet desiring to take the tactical offensive must (1) Locate the enemy. (2) Determine his strength and strategic objective. (3) Obtain constant information of his location, disposition and strength.

During these operations, however, the main force must be protected against surprise or observation; thus it is necessary to maintain with the main body a sufficient number of ships of the reconnoitering force for this duty of security.

In the second type, success depends upon avoiding the enemy. The reconnoitering force of the enemy is the principal obstacle to such success. In order to succeed the reconnoitering force of the fleet attempting to reach a strategic objective must (1) Destroy or draw off by deception the enemy reconnoitering force, or failing this (2) Deny the information desired by the enemy.

Before further discussion of the use of the reconnoitering forces,

definitions of the terms used in the discussion will be given in order that we may start from a common viewpoint.

Reconnaissance is the service, by forces within the theater of operations, of obtaining (1) Information of the enemy. (2) Information of local hydrographical or meteorological conditions. (3) Special information required by the commander-in-chief.

Aggressive Reconnaissance, or Scouting.—Operations of the reconnoitering forces with the mission of obtaining information for offensive action. It comprises three distinct types of operations:

(1) *Search.*—Operations to locate the enemy, more especially the enemy main force.

(2) *Strategical Scouting.*—Operations before the main bodies or destroyers are within striking distance, to determine the general direction of movement and strength of the enemy's main body upon which information the commander-in-chief is to base offensive strategical operations.

(3) *Tactical Scouting.*—Operations, when the main bodies or destroyers are within striking distance, to obtain constant information of the enemy main body's location, strength and disposition, upon which information the commander-in-chief is to base offensive tactical operations.

Protective Reconnaissance.—Operations to obtain such information of the enemy as is required to afford security to the main force, or upon which the commander-in-chief is to base defensive operations.

Offensive Screening.—Operations at a distance from the main body to obtain security for the main body by seeking out the enemy reconnoitering forces and defeating them, or deceiving them as to the location of the main body.

Defensive Screening.—Operations in the vicinity of the main body to deny information to the enemy, or by warding off the enemy, to afford security to the main body from minor attacks, surprise or observation.

SCOUTING.

The Search.—The object of the search is to locate the enemy, more especially the enemy main body.

The large area of the theater of operations of a war with an European power, in which we must search, requires the most efficient plan of operation, and coordination of effort of our forces.

Search operations cover a large portion of the theater of war and it is quite possible that such operations may extend over a period of several days without interruption or interference by the enemy.

In order to insure coordination between scouting ships, and to ensure that the proper areas have been searched, it will be necessary to adopt several standard methods of search.

The objection is sometimes raised that ships cannot in practice conform to the lines as given in geometrical methods, but it must be evident that an attempt to follow a system will, at least, give better results than if a system is lacking. Errors of navigation will prevent chart maneuver accuracy, but as the errors are indeterminate, plans must be made upon the assumption of accurate navigation.

The systematic employment of ships in the search, in chart maneuvers, has developed certain methods which have been called (a) The Out and In Method; (b) The Retiring Search Method; (c) The Trailing Method.

OUT AND IN METHOD.

In the *Out and In Method* a line of scouts is stretched across the path of the enemy's advance, each moving on a course parallel to the enemy's assumed course, to the front by day and to the rear by night. The distance between scouts should not be greater than twice the range of visibility of the force for which the search is being conducted and should not, in the enemy's most probable area, exceed four-thirds of such range of visibility. Spacing at four-thirds the range of visibility will permit the dropping out of one scout in three, due to accident or contact with the enemy, without seriously decreasing the efficiency of the scouting line, for, as soon as a scout finds it necessary to leave the line, she notifies the scouts on each side of her, each of which will incline towards the vacant space a distance of two-thirds the range of visibility; this reestablishes the line at distances of twice the range of visibility without serious danger of an enemy force having successfully passed the line.

In actual practice, weather conditions limit the scouting distance, and in case of fog or other weather conditions that seriously reduce the range of visibility, the scouting line should make a simultaneous movement to the rear. This must be effected by a radio signal.

This method of search is the most common. It is most advantageous in:

(1) Searching in a locality where there is reason to believe the enemy must cross the line of scouts; as when leaving or approaching a known port.

(2) When the estimate of the enemy's course will probably be more accurate than the estimate of his speed.

(3) When the enemy's time of departure is uncertain.

(4) When the speed of the scouting force is low, or when it is necessary to avoid the expenditure of coal.

The scouting line should be normal to the enemy's assumed direction of approach, in order to cover the widest front. Scouting should begin during daylight, at such point that had the enemy steamed direct from his last known position, at his assumed maximum speed, he could just have reached the position of the scouting line. If the enemy's time of departure is unknown, the scouting line should be formed immediately and advance to the front as explained below.

If the distance steamed to the front on a course parallel but opposite to the assumed course of the enemy, is equal to the distance that the enemy could steam during the night at his assumed maximum speed, it is evident that, if the scout retires an equal distance during dark, the successive daylight scouting positions will be the same. In this case, the scouting line is said to be "*Maintained to the front.*"

If, however, the scouts steam a greater distance to the front during the day than they retire at night, either by using greater speed or because daylight is longer than darkness, successive daylight scouting positions will be nearer the enemy's starting point. In this case the scouting line is said to be "*Advanced to the front*" an amount equal to the difference between the daylight steaming distance and the darkness steaming distance. In case successive daylight positions are farther from the enemy's point of departure, the line is said to be "Retired."

Diagram 1 is a sketch of the *Out and In Method* as it might have been used by a Japanese squadron in searching for the Russian fleet before its arrival at the Saddle Islands.

The area of the Eastern Sea lying between China and the Loo Choo group of islands is, on account of its narrowness, a very suitable place for the use of this method of search.

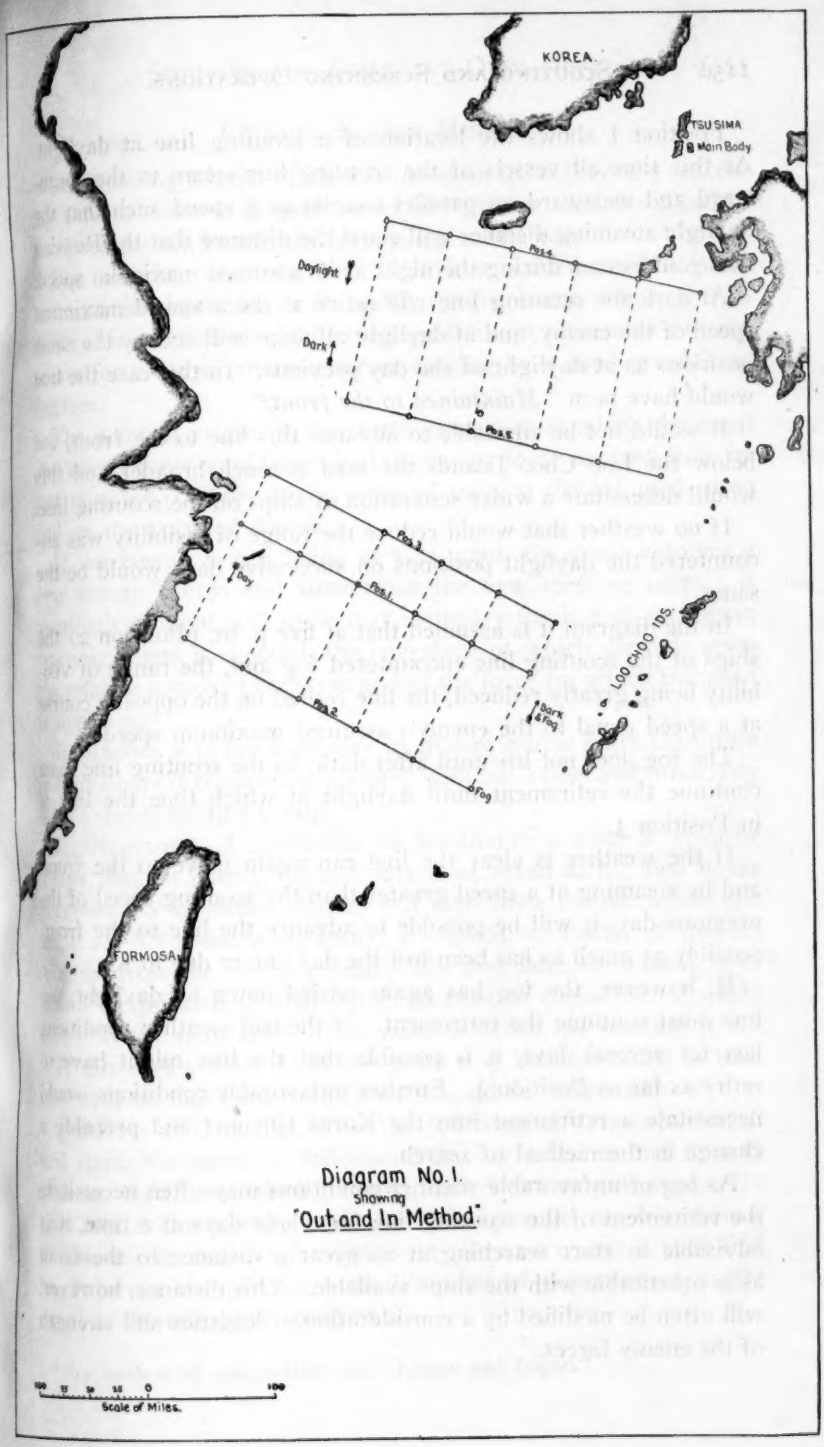


Diagram No. 1.
showing
"Out and In Method."

Position 1 shows the location of a scouting line at daylight. At this time all vessels of the scouting line steam to the southward and westward on parallel courses at a speed such that the daylight steaming distance will equal the distance that the Russian fleet could steam during the night at its assumed maximum speed.

At dark the scouting line will retire at the assumed maximum speed of the enemy, and at daylight all ships will occupy the same positions as at daylight of the day previous. In this case the line would have been "*Maintained to the front.*"

It would not be advisable to advance this line to the front, for below the Loo Choo Islands the area is much broader and this would necessitate a wider separation of ships on the scouting line.

If no weather that would reduce the range of visibility was encountered the daylight positions on successive days would be the same.

In the diagram it is assumed that at five p. m. (Position 2) the ships of the scouting line encountered fog and, the range of visibility being greatly reduced, the line retired on the opposite course at a speed equal to the enemy's assumed maximum speed.

The fog does not lift until after dark, so the scouting line must continue the retirement until daylight at which time the line is in Position 3.

If the weather is clear the line can again move to the front, and by steaming at a speed greater than the scouting speed of the previous day, it will be possible to advance the line to the front, possibly as much as has been lost the day before due to fog.

If, however, the fog has again settled down by daylight, the line must continue the retirement. If the bad weather conditions last for several days, it is possible that the line might have to retire as far as Position 4. Further unfavorable conditions would necessitate a retirement into the Korea Channel and probably a change in the method of search.

As fog or unfavorable weather conditions may often necessitate the retirement of the scouting line for whole days at a time, it is advisable to start searching at as great a distance to the front as is practicable with the ships available. This distance, however, will often be modified by a consideration of logistics and strength of the enemy forces.

RETIRING SEARCH METHOD.

The Retiring Search Method is based on the ability of a searching ship to steam at a speed materially greater than the speed of the force for which the search is being conducted.

The searcher assumes from his latest information, a point and time of departure and a speed for the enemy force, and so directs his course and speed as to pass through successive meeting points for assumed enemy courses varying by a small number of degrees.

The point of origin of the search is a point at which the scout and enemy force would meet had the enemy force steamed from its last reported position, at the assumed time, at the assumed speed and on the assumed course.

If the enemy is not found at this point, the scout assumes a new enemy course and steams for the new meeting point. A moment's thought will show that in theory the loci of successive meeting points is a spiral, the curvature of which depends upon the relative speeds of the scout and of the force for which the scout is searching.

In practice it is not necessary to change course more than once in four hours if conducting a search with one vessel and often only once a day if using a group.

In Diagram 2, A represents the position of a scout S when he learns that an enemy force E left B at seven a. m., two hours previous. S is certain that E will take some course within the angle α. S's speed is 20 knots; E's speed, 10 knots. S decides to scout from the northern limit. The first calculation must be to obtain the position O where, if E steamed on course BO, S could arrive at the same time. This point is called the meeting point.

If distances are not great this point may be determined by trial and error on the chart, but if great, should be computed.[a]

S arrives at O at 6.45 a. m. the following day, fails to find E and starts his search as follows: S having failed to find E at O assumes that E has taken a course further to the southward. He now locates the meeting point for a future time, say four hours, and steams at 20 knots for that point. S's new course is such that he increases his distance from E's point of departure at a rate equal to the estimated speed of E.

[a] For method of computation see "Knapp and Logan."

It is evident from the diagram that S has passed successively close to all meeting points lying on courses between BO and BX. S examines successively probable enemy courses until dark. On account of the reduced visibility, at dark S must take up a course on the radius from B passing through his dark position X and reduce his speed to that assumed for E. At daylight the process of exhausting possible courses is continued until E is located by S at Y.

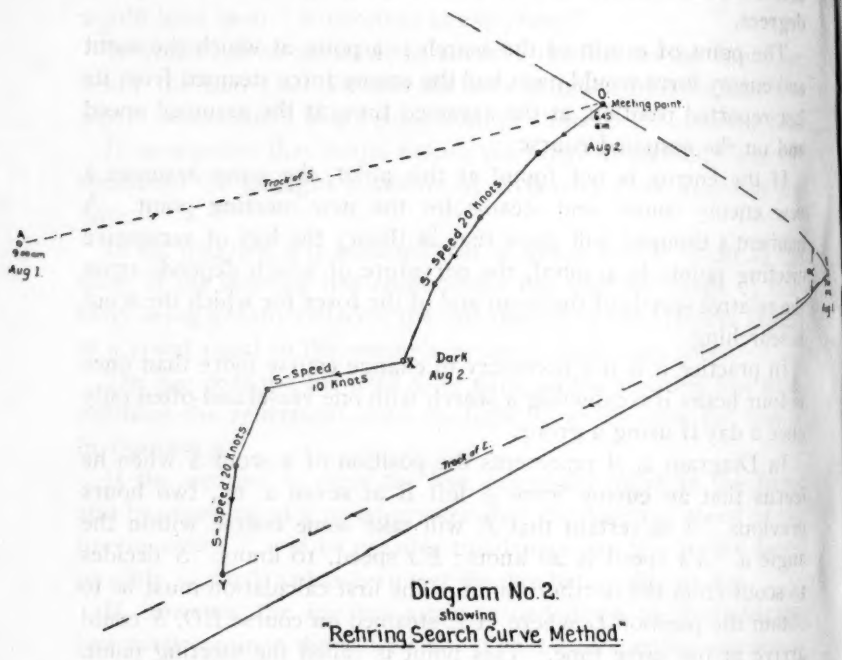


Diagram No. 2.
showing
"Rehring Search Curve Method."

The above assumptions concerning the enemy, known hour of departure, known and uniform speed, and steady course, are purely theoretical and seldom, if ever, could be found in actual practice. It is, therefore, necessary to use several vessels to cover various assumptions of enemy time of departure and speed. While an enemy speed may not be uniform it is only necessary to cover his average speed up to the time of sighting.

Under modern conditions of rapid radio and cable communication, it is quite probable that the time of departure of an enemy's force will be known with a fair degree of accuracy, and

his speed, barring accident, can often be estimated within a limit of error of several knots.

In searching for an enemy fleet the large radius of visibility of its smoke is of much aid to the searchers.

The *Retiring Search Method* is advantageous when:

(1) The enemy's speed and time of departure from a given point are closely known but destination doubtful.

(2) The number of scouts available is small, but their speed high.

(3) Scouting begins close to and soon after the departure of the enemy from a given position.

(4) When the scouting force starts from a position on the enemy's flank.

In all cases, however, the scouting force must have a speed materially greater than the speed of the group for which the search is being conducted, and a sufficient supply of fuel to maintain such high speed during each daylight of the search.

In using a large number of scouts by this method three systems have been developed:

(1) Independent Retiring Search.

(2) Retiring Search Curve Patrol.

(3) Retiring Search Sector Method.

In the Independent Retiring Search each scout is given a different assumption as to the enemy's speed or time of departure. Each ship conducts an independent search on the assumptions given.

This method permits of the best use of each individual ship and is perhaps the most efficient for the search considered alone, but by its use the scouts become widely dispersed and the efficiency of cooperation for the purpose of strategical scouting is greatly reduced.

(2) In the Retiring Search Curve Patrol scouting is started by all vessels of the group from the same point, called the "point of origin," with the same assumptions as to enemy's speed and time of departure, but at intervals of time such that the ships of the patrol are separated by not more than twice the range of visibility of the force for which the search is being conducted.

This patrol covers a portion of the search curve for lower speeds of the enemy or for a later time of departure.

At dark, if this method is to be continued the following day, all vessels retire at the enemy's assumed maximum speed on a course parallel to that taken by the leader, which is the line from the enemy's point of departure passing through his dark position. Courses parallel to that of the leader during the retirement, assure the proper spacing of the scouts at daylight.

This method can often be used when taking up a position for the Out and In Method, Case I (Diagram 4) or when retiring from a scouting position the occupation of which is no longer necessary, Case II (Diagram 5). If the time available for forming a scouting line for the Out and In Method is great, a search curve patrol may be run to such position, thus perchance reducing the work of another group of scouts (see work of Squadron Three in the theoretical campaign, Diagram 3).

Case I.—Squadron *X* consisting of eight 18-knot cruisers at anchor in Guantanamo, receive instructions at noon, 2 August, as follows:

"Enemy fleet and train, weakly screened, in MONA PASSAGE, eight-thirty p. m., one August.

Our main body and destroyers, etc. . . . .

Squadron *X* search for enemy main body. Assumed destination COLON."

The squadron commander decides:

(1) To assume enemy's maximum speed at 12 knots.

(2) To occupy at daylight, 4.30 a. m., as much of the enemy's daylight curve as can be reached by ships of his squadron.

(3) To search during daylight 3 August, by retiring search curve patrol, point of origin, Lat. 16° 10′ N., Long. 74° 20′ W., scouting distance sixty miles.

(4) To retire during night of 3-4 August to scouting line one seventy degrees Southern scout Lat. 10° 20′ N., Long. 75° 50′ W., scouting distance sixty miles.

(5) To scout during 4 August by Out and In Method. Course sixty-seven degrees. *C-1* will adjust course to shore line.

(6) To maintain this line to the front.

From the diagram, it will be seen that had the commander of Squadron *X* decided to use only the Out and In Method, he could not have formed his line until 4 August. The position would be on the line *e-f*, which is tangent at its center to the enemy's maximum speed position circle for daylight 4 August.

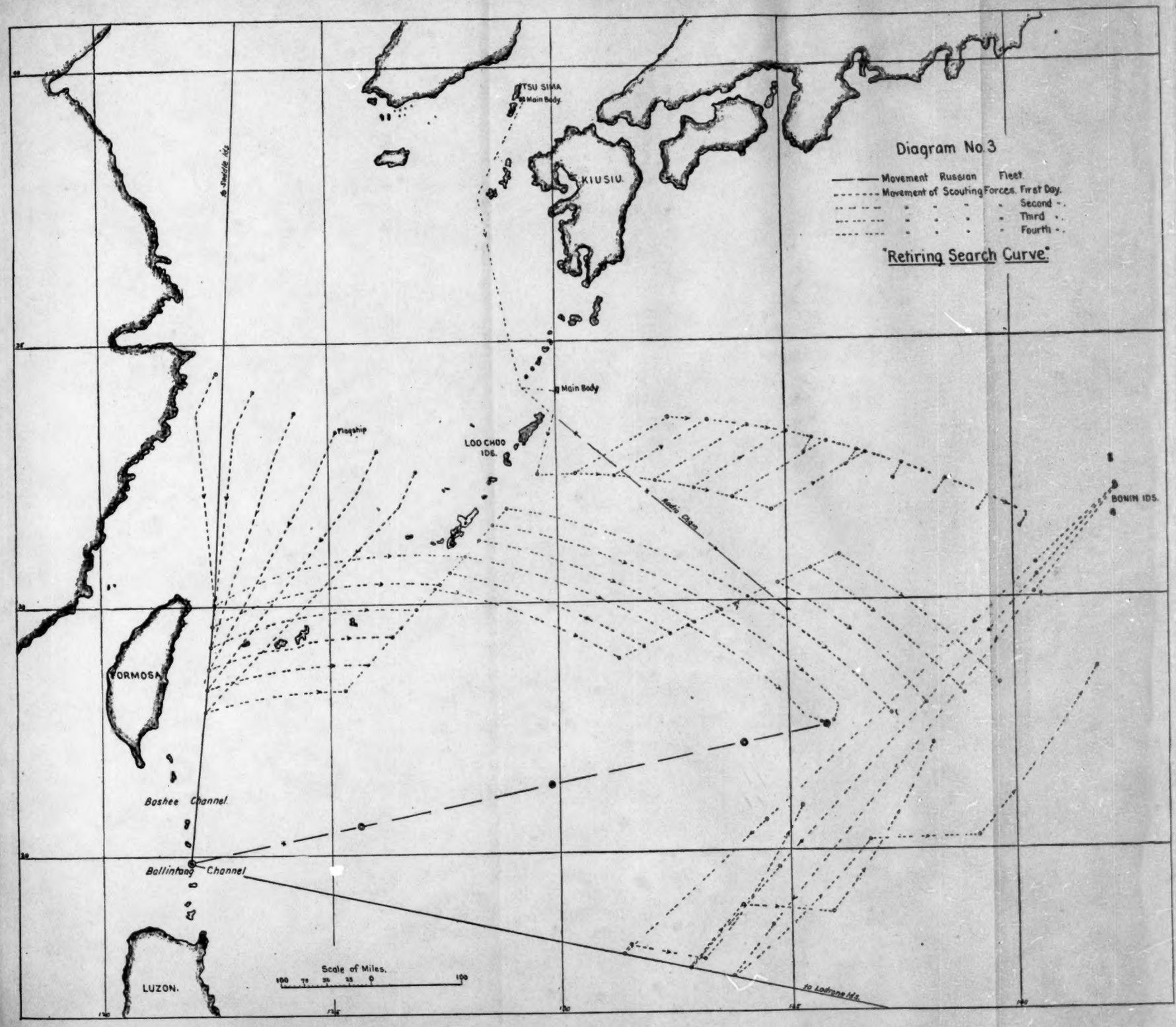


Diagram No. 3
Movement Russian Fleet
Movement of Scouting Forces. First Day.
Second
Third
Fourth
"Retiring Search Curve."
TSU SIMA
Main Body.
KIUSIU.
Tsugaru Kio
Main Body
Flagship
LOO CHOO IDS.
Idzu Oshima
BONIN IDS.
FORMOSA
Bashee Channel
Ballintang Channel
LUZON.
Scale of Miles.
100 75 50 25 0 100
To Ladrone Is.

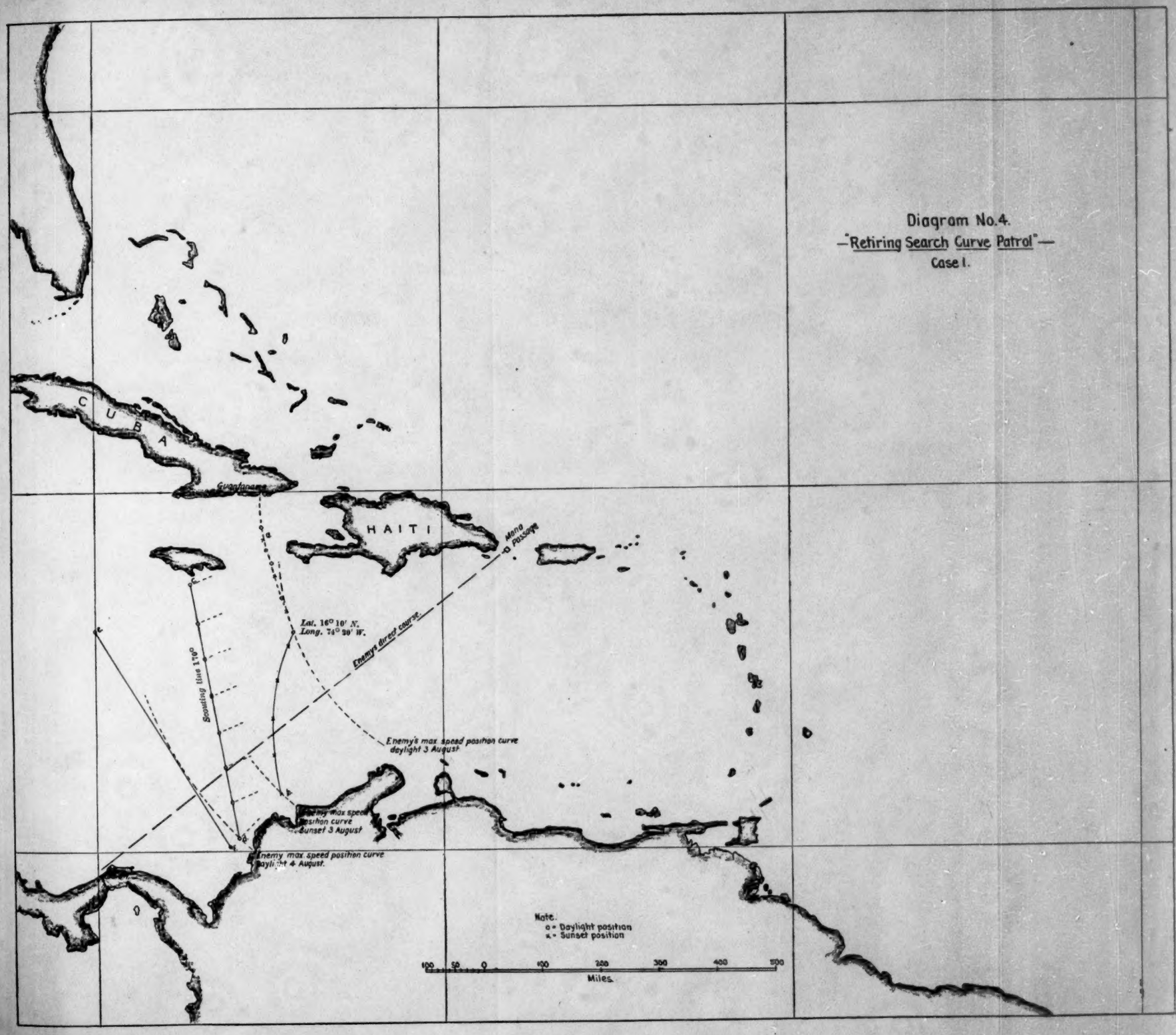
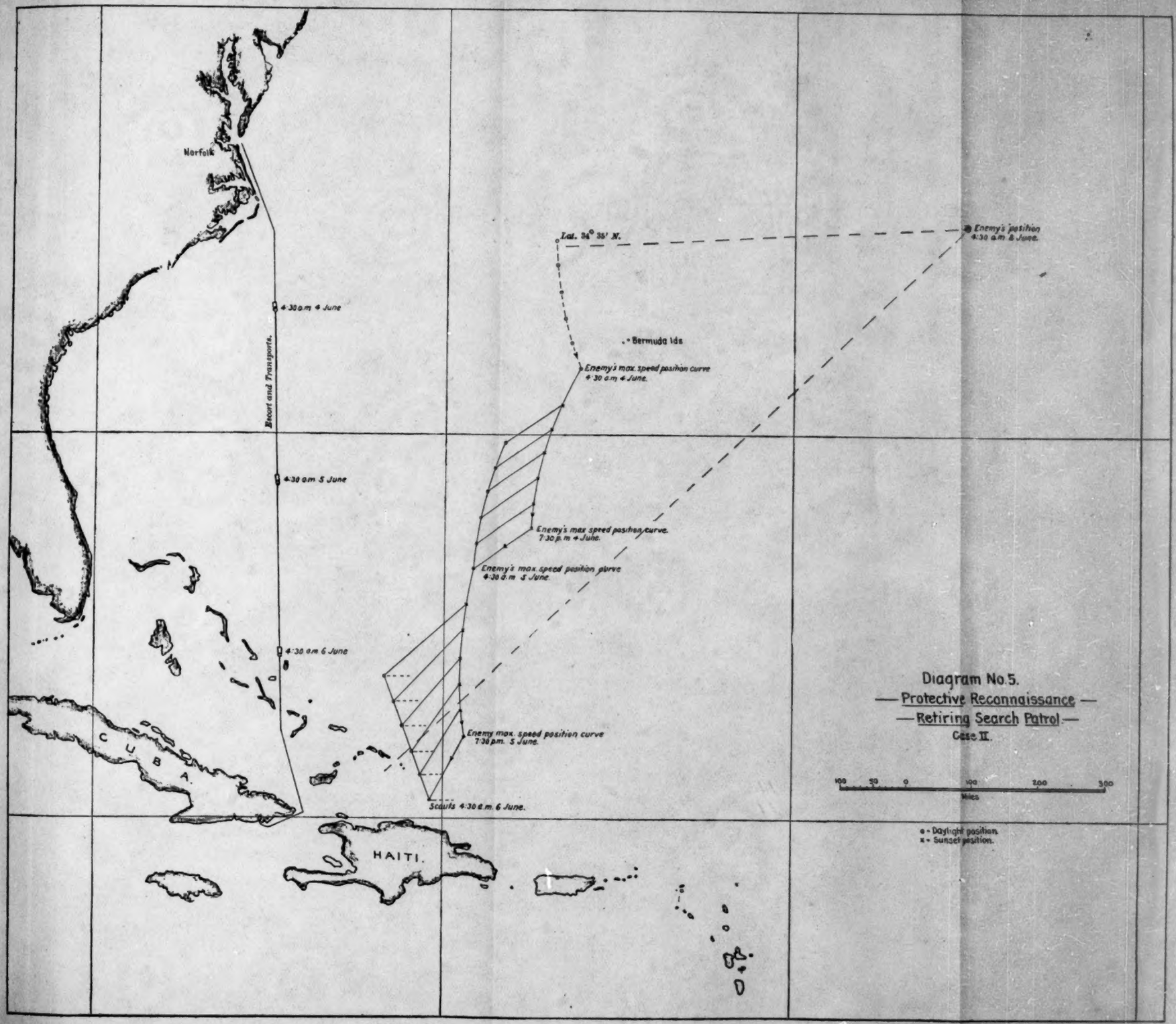


Diagram No.4.
—"Retiring Search Curve Patrol"—
Case I.


Norfolk
Escort and Transports.
4·30 a.m 4 June
4·30 a.m 5 June
4·30 a.m 6 June
Lat. 34° 35' N.
Enemy's position 4·30 a.m 5 June.
Bermuda Ids
Enemy's max. speed position curve 4·30 a.m 4 June.
Enemy's max speed position curve. 7·30 p.m 4 June.
Enemy's max. speed position curve 4·30 a.m 5 June.
Enemy max. speed position curve 7·30 p.m. 5 June.
Scouts 4·30 a.m. 6 June.
CUBA
HAITI.
Diagram No. 5.
— Protective Reconnaissance —
— Retiring Search Patrol —
Case II.
100 50 0 100 200 300
Miles
o = Daylight position.
x = Sunset position.

ITIAH

In using the retiring search curve patrol to gain his position for the use of the Out and In Method, he covers as much of the enemy's maximum speed position curve for daylight 3 August as can be reached by that time, spacing his vessels at distances of sixty miles.

At daylight the leading ship starts the retiring search curve for enemy's assumed maximum speed. The point at which this ship starts the curve is the point of origin. As each vessel reaches the point of origin, she takes up the retiring search curve as steamed by the leader.

At dark, 7.30 p. m., the ships will hold the line *a-b*, spaced along the line at sixty miles distance. If the assumed radius of visibility is not too great, the enemy must at that time be to the eastward of line *a-b*.

At dark all ships retire to their stations on line *c-d*. As each ship retires at a speed equal to or greater than twelve knots until daylight, it is known that the enemy lies to the eastward of this line at daylight.

At daylight, the Out and In Method is started on course sixty-seven degrees true.

Case II.—This case shows the value of the retiring search curve patrol in retiring from scouting positions which it is no longer necessary to hold.

A convoy of ten troop ships, under escort of three second-class battleships and six merchant scouts, is at anchor in Hampton Roads taking coal, stores and troops. This force is under orders to proceed to GUANTANAMO at the earliest possible moment. The merchant scouts are ready to sail by noon, 2 June; the convoy will not be ready until daylight, 3 June. Speed of scouts 18 knots; speed of convoy 10 knots.

At 1.00 p. m., 2 June, the commander of this force receives information by radio that an enemy force of six second-class battleships was sighted at 4.30 a. m., 2 June, in Lat. 35° 00′ N., Long. 55° 00′ W. Heading to westward.

He decides: (1) To use his six scouts for protective reconnaissance some distance from the convoy, assuming that early information of the enemy will assist him in eluding the superior force. (2) To proceed at earliest moment at maximum speed on direct course towards Guantanamo.

At daylight, 4 June, his main force will be $1115-240=875$ miles from Guantanamo. Assuming enemy maximum speed as 12 knots, the enemy force must be within $\frac{12}{10}\times 875=1050$ miles of Guantanamo, if possible to intercept the convoy. This distance from Guantanamo upon the enemy's maximum speed position curve for 4.30 a. m., 4 June, is in Lat. 34° 35′ N., Long. 66° 50′ W. To threaten the convoy, the enemy must be to the southward of Lat. 34° 35′ N. at this time.

If the six scouts are placed on this position curve forty miles apart, the northern scout in Lat. 34° 35′ N., Long. 66° 50′ W., they will cover a sector of the position curve from the most northern position from which this enemy force could threaten the convoy.

At daylight the southern scout starts a retiring search to southward and westward, assuming enemy speed as 12 knots. The other scouts proceed along the daylight position curve to the point of origin, then take up the search curve steamed by the leader.

At sunset all scouts retire on course of the leader at 12 knots. The day of 5 June, the search curve patrol is again used. At dark of 5 June, the scouts retire to a scouting line one sixty degrees true and on 6 June will use the Out and In Method.

If the enemy is not discovered, he has reduced speed to such an extent that the interception of the convoy is impossible, or has passed to the northward of the scouts, in which case he cannot overtake the convoy.

The third form of the Retiring Search Method is known as the *Retiring Search Sector Method.* In this method the scouts take up positions on a radius from the enemy's last reported position, and separated on this line by distances equal to the difference in assumed enemy speeds multiplied by the number of hours since the enemy left his last reported position.

In searching for an enemy whose limits of speed are assumed to be 8 and 12 knots, the group must cover a distance along the radius equal to $4\times 24\times y=96y$, where y is the number of days steaming of the enemy from his last reported position.

If the enemy has only steamed one day before the line is formed, the distance will be 96 miles and, if six ships are available, they will be separated by 16 miles. From this it is evident that the sooner the search begins after the time of the enemy's departure from his last reported position the greater will be its efficiency.

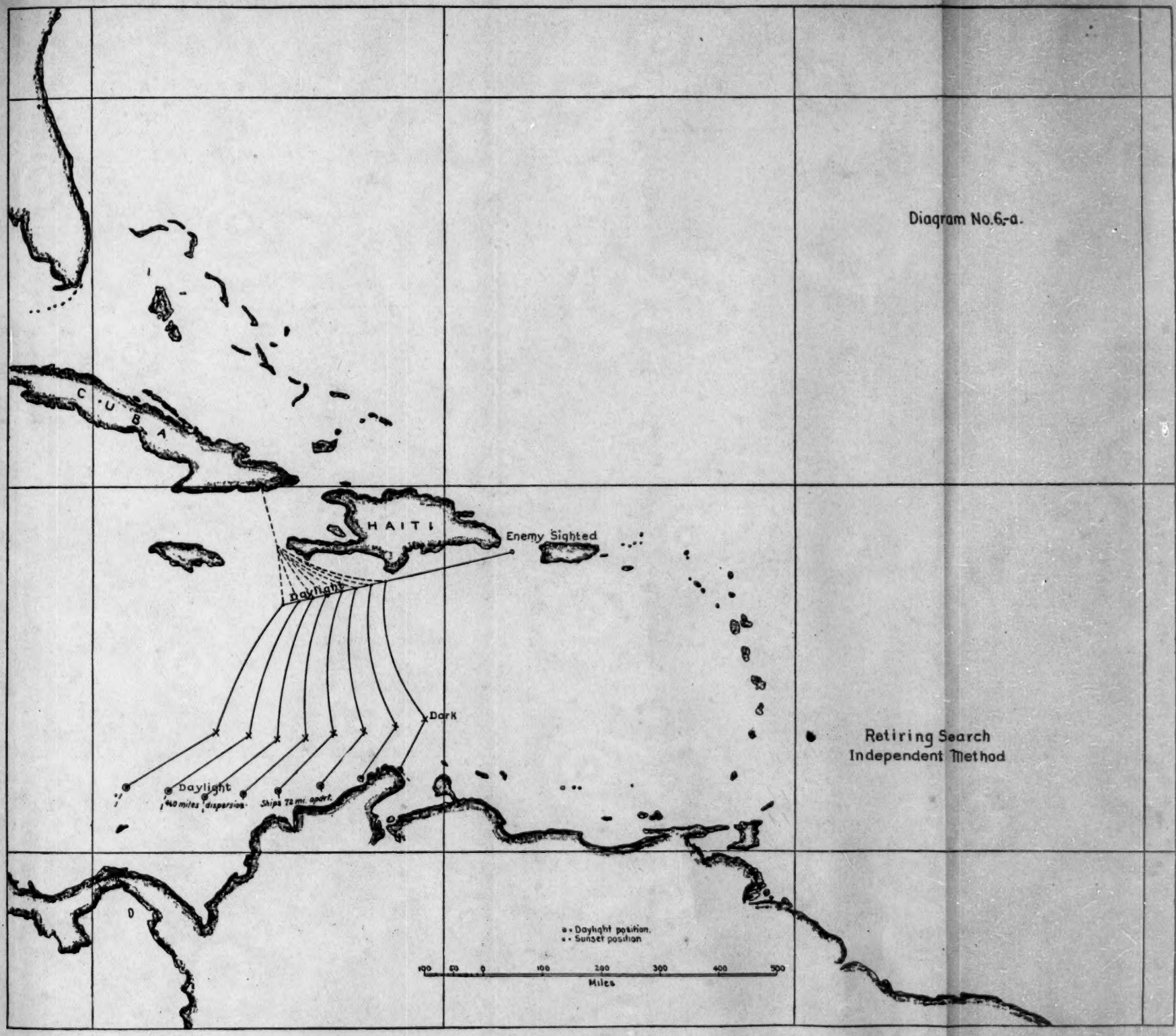


Diagram No.6.-a.
C U B A
HAITI
Enemy Sighted
Daylight
Dark
Daylight
40 miles dispersion
Ships 72 mi. apart.
Retiring Search
Independent Method
D
• Daylight position.
• Sunset position
100 50 0 100 200 300 400 500
Miles

HAITI

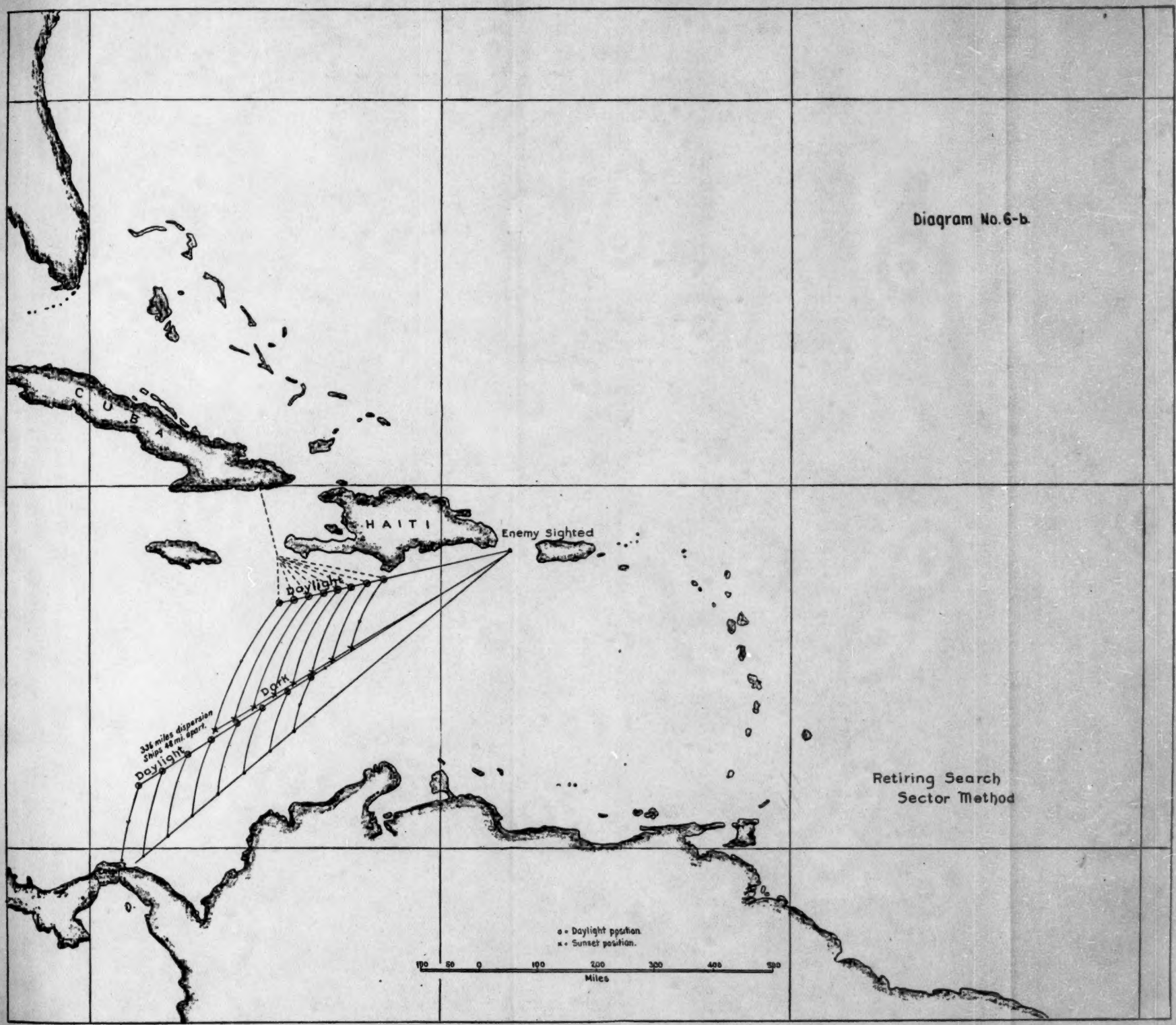
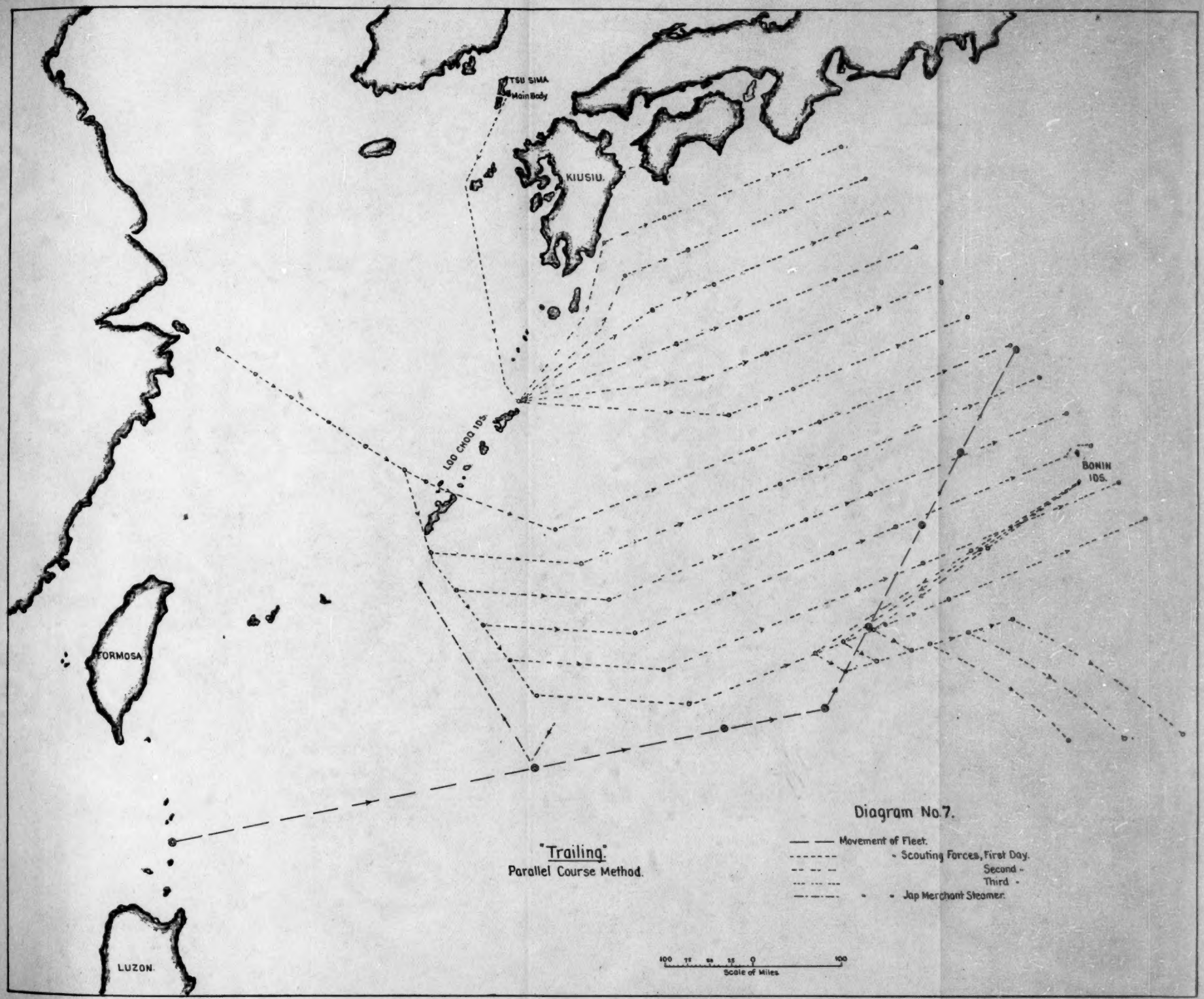


Diagram No. 6-b.
CUBA
HAITI
Enemy Sighted
Daylight
Dark
336 miles dispersion
Ships 48 mi. apart.
Daylight
Retiring Search
Sector Method
o - Daylight position.
x - Sunset position.
150 50 0 100 200 300 400 500
Miles


TSU SIMA
Main Body
KIUSIU.
LOO CHOO IDS.
BONIN IDS.
FORMOSA
LUZON.
"Trailing"
Parallel Course Method.
Diagram No.7.
Movement of Fleet.
Scouting Forces, First Day.
Second "
Third "
Jap Merchant Steamer.
100 75 50 25 0 100
Scale of Miles.

What has been said so far with regard to this method applies equally well to the independent method of search. The difference from now on is this: In the independent method each ship is given an assumption upon which the search is conducted without regard to any other ship, while in the sector method all ships search a given sector during each daylight, regulating their speed to finish the day's search on a given radius. The radius limiting the sector to be searched is assigned by the group commander, and is limited by the arc that can be searched by the scout searching on the highest enemy assumed speed. This radius is a line of bearing from the enemy's last reported position.

This limitation to a given sector maintains the scouting line on a slowly changing line of bearing and maintains concentration as much as possible. During the progress of the scouting the distances between the ships will be gradually increased, the increase in distance between two ships being in one day equal to the number of hours of daylight multiplied by the difference of assumed speeds. If the daylight was fourteen hours long and the difference of assumed speeds one knot, the scouting distance would be increased, during daylight, fourteen miles.

All scouts of this group arrive at the same radius at dark and retire during the night on the same course. The speeds during the night will vary slightly, as during this time the distance between ships must be increased by an amount equal to hours of darkness multiplied by the difference in the enemy assumed speeds.

Diagrams 6a and 6b show the variation in the work of a squadron of eight scouts when using the Independent Retiring Search and Retiring Search Sector Method, under conditions given in Case II.

In the sector method, the ships nearest the point of departure of the enemy steam at speeds slower than those of the more distant ships. It is therefore possible to maintain the concentration of a non-homogeneous squadron by this method by placing the fast ships on the outer arcs and the slower ones on the arcs nearer the enemy's point of departure.

If the squadron is homogeneous, fuel may be economized in this method by causing the ship having searched the outer arc on one day to search the inner arc on the succeeding day.

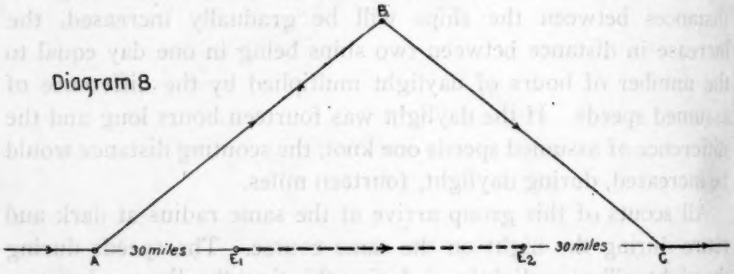
TRAILING.

Trailing is the general name applied to the methods of searching from the rear.

In practice it usually takes one of two forms, namely: Parallel course trailing and Diagonal course trailing.

(1) *Parallel Course Trailing.* (Diagram 7).—In this form scouts run on a series of lines, each parallel to the enemy's assumed course, separated by a distance not greater than twice the range of visibility of the body for which the search is being conducted. The daylight speed is as high as possible, in order to overtake the enemy who, by hypothesis, is ahead. The night speed is the lowest assumed speed of the enemy, for if a higher speed is used the enemy might be passed during the night.

Diagram 8



(2) *Diagonal Course Trailing.* (Diagrams 8, 9, and 10).—This form of trailing is used when the number of scouts available is insufficient to cover the desired front by the method just described. It is accomplished by the scouts steaming on a series of diagonal courses, returning to a point on their original line one or more times during daylight. The courses of the scouts are parallel.

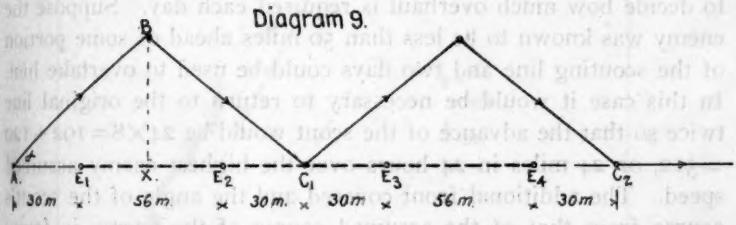
The amount of front that can be covered is dependent upon the speed of the scouts; the assumed maximum and minimum speed of the enemy; the range of visibility; and the desired rapidity of overhauling the enemy.

It is evident that the enemy will be overhauled in the shortest time if the scout steams on a course parallel to that of the enemy. Any variation therefrom, in order to increase the front searched, reduces this rapidity of overhaul. Each case must be considered separately in order to properly balance these two factors: front and rapidity of overhaul.

In Diagram 8 a scout at A could see an enemy nearer than E_1 or A-E_1 equals the range of visibility which, for a fleet, may be assumed at 30 miles. The scout steams on the diagonal course to B then returns to the original line $A\ C$ at C. If E_1 to E_2 equals the distance the enemy would steam in the same time at his minimum speed and E_2C equals the range of visibility, it is evident that the distance $AC = 60 +$ (enemy's minimum speed $\times$ hours elapsed between time of departure and time of return of the scout to the original line). In order to overhaul the enemy, if he is steaming at his assumed maximum speed, AC must be greater than, enemy's maximum speed multiplied by above mentioned time interval.

By his return to the original line, the scout has assured himself that he has not passed the enemy either on or to the left of line AC. He may now start off again on a course parallel to AB,

Diagram 9.



returning to the original line at a distance from $C = 60$ miles + distance enemy could steam in elapsed time at his minimum speed.

For each return to the original line, the scout has covered a distance to the front equal to 60 + distance enemy could steam at his minimum assumed speed during the period elapsing between successive positions of the scout on the original line.

The rate of overhaul for enemy's assumed maximum speed is equal to 24 $\times$ enemy's minimum speed + $(y \times 60) - 24 \times$ enemy's assumed maximum speed, where y equals the number of returns to the scouting line and 30 miles is considered as the range of visibility. If minimum speed is 8 knots and maximum speed 12 knots and the scout makes two returns to original line, the overhaul per day is—

$(24 \times 8) + (2 \times 60) - (24 \times 12) = 312 - 288 = 24$ miles per day.

The scout returns twice as shown. Each leg of his diagonal course would take $\frac{14}{4} = 3.5$ hours (14 being hours of daylight). At twenty knots he could steam 70 miles in 3.5 hours, or $AB = 70$

miles. $AX=30+28=58$. In triangle ABX, $AB=70$, Angle $a=34°$. The scout's course thus makes an angle with original line equal to 34°. $BX=39$. The increase in front searched is then 39 miles for each scout.

At 12 knots the enemy would steam 288 miles in 24 hours.

At 8 knots, the enemy would steam 192 miles in 24 hours.

The scout must steam at 8 knots for 10 hours during darkness which = 80 miles. This reduction in speed must be made to avoid passing the enemy during darkness.

In order to gain on the enemy if he was steaming at 12 knots, the scouts must advance more than 208 miles during daylight ($288-80=208$). At 8 knots the enemy's advance would be 112 miles; the difference, 208 miles minus 112 equals 96 miles, must be made up by visibility distance gained by returns to the original line. The gain for each return is 60 miles. It is necessary now to decide how much overhaul is required each day. Suppose the enemy was known to be less than 50 miles ahead of some portion of the scouting line and two days could be used to overtake him. In this case it would be necessary to return to the original line twice so that the advance of the scout would be $24\times8=192+120=312$, or 24 miles in 24 hours over the highest enemy assumed speed. The additional front covered and the angle of the scout's course from that of the assumed course of the enemy is found from the traverse table, as above.

Trailing is effective during daylight as all the area covered is covered thoroughly. It may fail at night if the enemy's actual speed is lower than his assumed lowest speed or if his course is changed so that the component of his speed along the assumed course is less than his lowest assumed speed.

Its other advantages are:

(1) Smaller chance of scouts being detected.

(2) Dispersion of enemy forces to the rear if attempting to drive off the scouts.

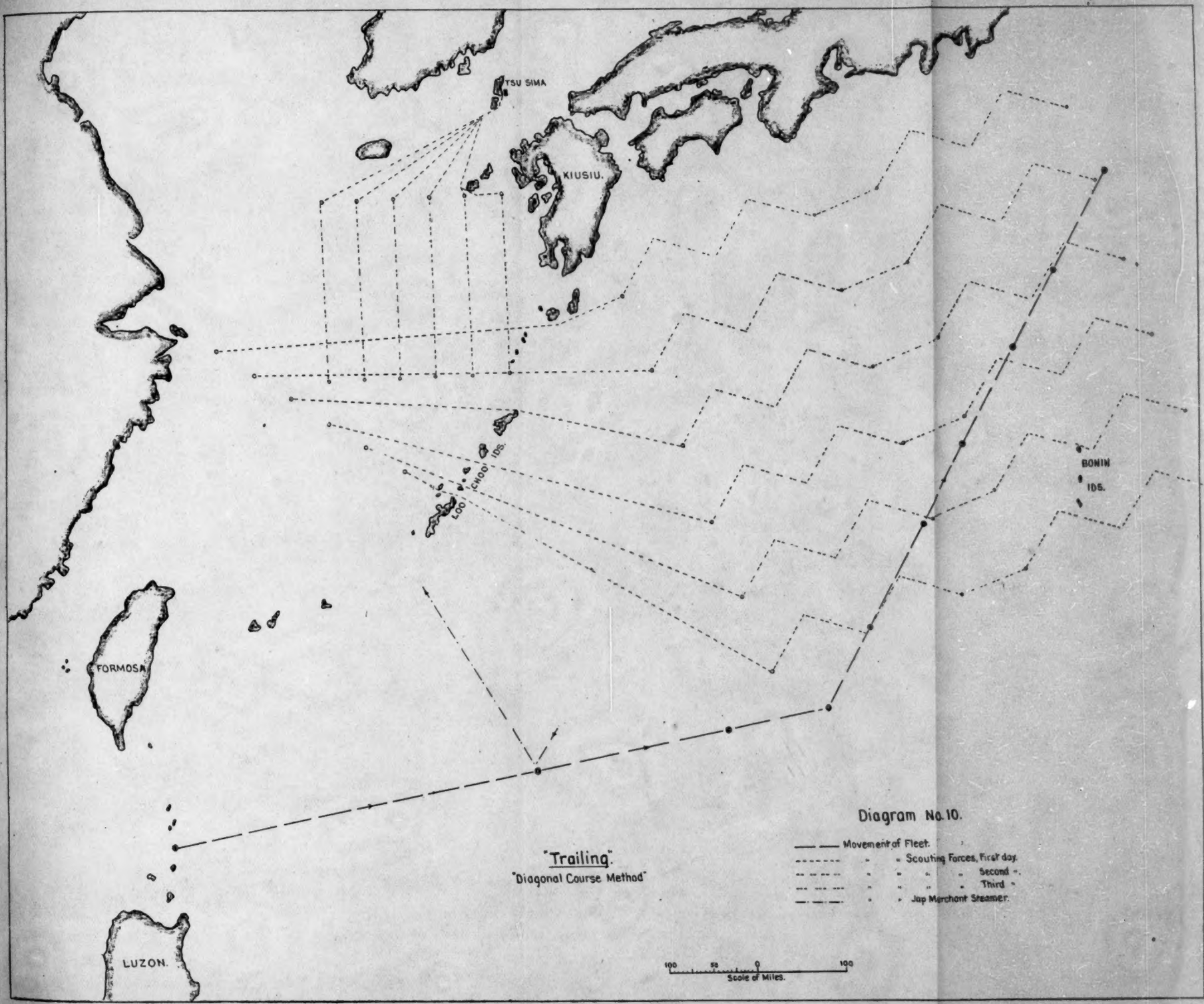
Its disadvantages are:

(1) Must be based on recent accurate information.

(2) Great amount of steaming to get in rear of enemy.

(3) Wide dispersion of forces.

In the preceding description of methods of using the scouting force the enemy has been assumed to be acting on the strategical offensive. The scouts were therefore at liberty to use methods


TSU SIMA
KIUSIU.
LOO CHOO IDS.
BONIN IDS.
FORMOSA
LUZON.
"Trailing".
"Diagonal Course Method"
Diagram No. 10.
Movement of Fleet.
Scouting Forces, First day.
" " Second "
" " Third "
Jap Merchant Steamer.
100 50 0 100
Scale of Miles.

of search in each of which the line could retire if it so desired.

The case is quite different when the search has to be conducted on the strategical offensive. With one exception the methods of search that have been described are not suitable.

SEARCHING, STRATEGICAL OFFENSIVE.

If our main body is advancing in the theater of war, the main body of the enemy is probably lying in a position in readiness. This assumption cannot be considered a surety and any system of search that failed to consider the possibility of the enemy main body advancing would be defective.

In order to be sure that the enemy main body does not pass the scouts during darkness, either the line must retire towards our main body during dark, at the enemy's assumed maximum speed, or there must be two lines of scouts placed at a distance apart equal to the night steaming distance of the enemy at his assumed maximum speed, plus the night advance of the scouts.

This necessity for advancing the scouting line practically prohibits, on account of excessive speed required, any form of scouting other than the *Out and In Method* using one line of scouts, or two lines as stated above.

These two methods will be compared both as regards number of ships and speed required under the following assumed conditions:

Front to be covered = 600 miles.
Own main body speed = 9 knots.
Enemy main body maximum speed = 12 knots.
Maximum speed of scouts = 23 knots.
Daylight = 14 hours. Night = 10 hours.

OUT AND IN METHOD.

See diagram 11.

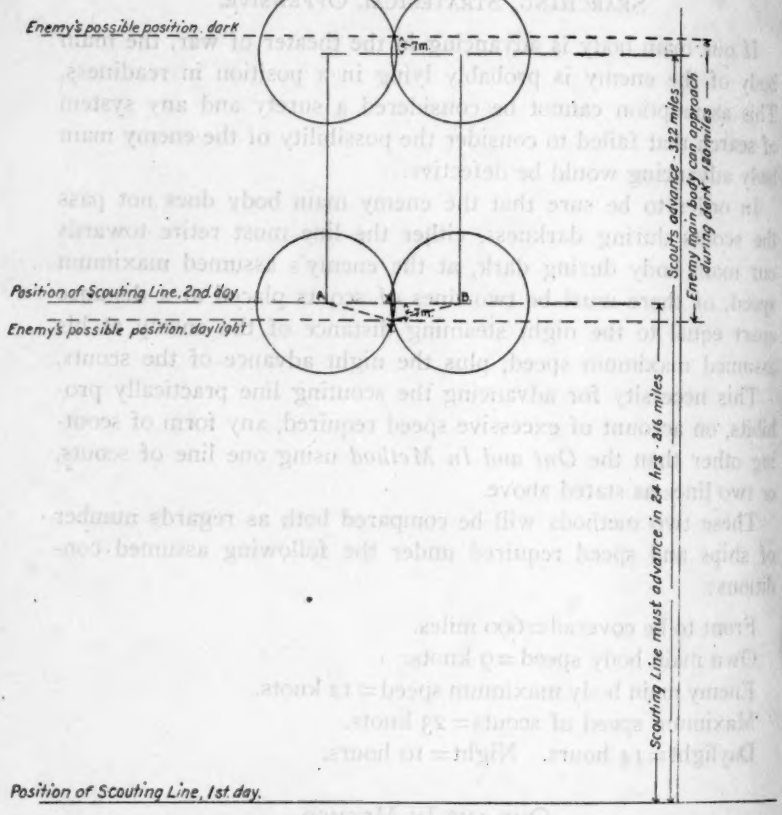
Enemy main body may approach during dark = 120 miles.
Scouting line must advance during 24 hours = 216 miles.
Scouting line advances during day $23 \times 14 = 322$ miles.
$322 - 216 = 106$ miles that scouting line can retire.

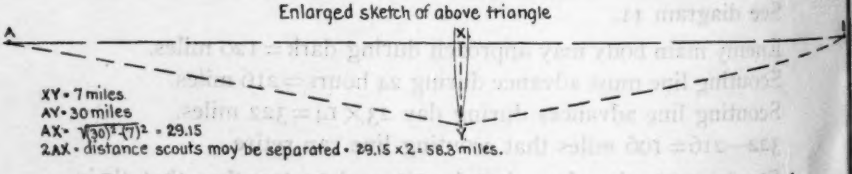
Scouts must, therefore, be placed so close together that their radii of visibility intersect seven miles ahead of the line joining their positions as shown in Diagram 11.

Assuming radius of visibility as 30 miles, the scouts will be separated by a distance

$$2\sqrt{(30)^2-(7)^2}=58.3 \text{ miles.}$$

Diagram 11.


Enemy's possible position, dark
7m.
Position of Scouting Line, 2nd day
A
X
B
3m.
Enemy's possible position, daylight
Scouts advance · 322 miles
Enemy main body can approach during day · 120 miles
Scouting Line must advance in 24 hrs · 816 miles
Position of Scouting Line, 1st day.


Enlarged sketch of above triangle
A
X
Y
XY = 7 miles
AY = 30 miles
AX = √(30)²-(7)² = 29.15
2AX = distance scouts may be separated = 29.15 × 2 = 58.3 miles.

In order to cover a front of 600 miles, 11 scouts will be required. They will steam 23 knots an hour for 14 hours and 10.4 knots an hour for 10 hours. Each scout will steam 426 miles in 24 hours.

By the method of two lines, 20 scouts will be required. Each scout will steam 216 miles in 24 hours.

By using the *Out and In Method,* high speed is essential and if the enemy main body can make 15 knots the method is practically prohibited. Under the best circumstances the expenditure of coal will probably prevent its use.

In the above discussion, it has been assumed that the scouting force is not preceding the main body by a great distance. The difficulties of this method of search are many as has been shown. It seems probable, therefore, that the scouting force would precede the main body some days, accompanied by colliers, and after coaling on the enemy's side of the ocean, search by retiring methods, first described, until their own main body approached.

CHOICE OF METHODS.

In the previous discussion of methods of search, the advantageous conditions for the use of each have been given. It may be possible in many cases, however, to use any of them.

There are several other factors in any given situation which may limit the methods that may be employed. These factors are: Area to be searched, number of ships, their speed, the amount of fuel on board, the availability of further fuel supply and the relative strength of the enemy reconnoitering forces.

The first point to be determined in any situation is the area to be searched. A careful estimate of the situation should be made to determine the enemy's probable intentions and the alternate courses of action that appear possible for him to adopt.

If the enemy is known to have left a certain point at a known time, circles may be drawn representing the loci of his possible positions at each daylight for any assumed speed. Drawing these circles for his highest and lowest assumed speed for daylight and dark, an area is determined in which search is profitable.

Searching in an area that the enemy could not have reached at his maximum speed is manifestly wasted energy. Searching is only profitable during daylight and only under special circumstances can it be justified at night.

Each area covered should be searched thoroughly. Negative information is valuable. Indifferent search is wasted energy for no deductions can be drawn from such work.

The aid rendered by a well organized intelligence service is here very well marked for if the enemy's exact force is known, his speed may be closely estimated and if his objective is known, the area to be searched may be greatly reduced. Such decrease in area increases the strength in the searching area and greatly augments the chance of success.

Having decided upon the area to be searched, it is necessary to select a method. Often it may be possible to use any one of several of the methods previously described.

In selecting from several available methods, attention should be paid particularly to logistics and concentration of force.

If the enemy's reconnoitering force is much superior, the intervals between ships should be small and the scouting line supported by heavier ships.

It may be necessary to use several different methods in order to cover the entire area.

"Instructions to reconnoitering forces should contain:

(1) All that is known of the enemy.
(2) Statement of the general situation.
(3) Indication of proposed direction of effort and objective."[4]

The first evidence of the enemy will probably be one or more contacts along the scouting line with ships of the enemy reconnoitering force. The action of the enemy ships may indicate the nature of the action their main body is attempting for, if their main body desires to take the tactical offensive, perhaps these ships may pass on without engaging, hoping to obtain information of our main body.

It will usually be the case, however, that if one's own main force desires to take the tactical offensive the enemy main force will not, in which case it is the duty of these enemy ships to engage.

It is important for the searching ships to avoid engagements, unless of markedly superior force, and such engagement is necessary in carrying out their mission of gaining information. If compelled to change course to avoid engagement, a scout should take such course as will soonest avoid the enemy and permit a return to the original plan of operations. The necessity for leaving station should always be reported to the ships next on each side and to the group commander, with a statement of the action to be taken with regard to the enemy.

[4] Bernhardi.

The force carrying on the search must not concentrate immediately upon contact with enemy reconnoitering ships, for the presence of enemy reconnoitering vessels is not a sure indication that the enemy main body is in the vicinity. If the enemy could count on such a concentration it would be easy for his main body to pass the line at a different point during such concentration.

The support for the scouting line may be directed to steam in the direction of these contacts, but such contacts must not weigh too heavily in making a decision, for they may be only a means to draw attention from the real point at which the enemy intends to pass.

Until the enemy main body is located the searching forces will probably have many uneasy moments, but it should be remembered that ships on search duty should continue in their own area until the enemy main body is located, or until their instructions have been changed.

It may be said that usually the resistance to a scouting force will be greater the nearer it approaches to the enemy main body. As has been pointed out this may not be true but if the force of the enemy screen becomes so great as to endanger our reconnoitering forces we must send in our support to clear up the situation.

It may often be necessary for the support of a scouting line to break through an enemy screen in order to determine what force, if any, lies behind.

In case there is no support for the scouting line, the line may have to concentrate and reconnoiter as a group. Such procedure confines the area covered to very small limits and should only be attempted when all other means fail.

The enemy main body must be located at the earliest practicable moment. Stealth is preferable to force in obtaining this information and it is in such situations that aeroplanes or flying boats may be of immense value.

The necessity for the use of force in attempting to gain information of the enemy is greatly dependent upon the immediate value of such information to the commander-in-chief.

It will be readily seen that an enemy's screen in the position anticipated by the commander-in-chief need not be developed with the same rapidity as a screen in a position far from the anticipated one.

A careful consideration of the value to the commander-in-chief of the development of a screen will furnish the best guide as to how much is to be sacrificed to gain information of what lies behind.

It must ever be kept in mind that during this phase of a campaign the strategic plan of operations of the commander-in-chief is governed by the information from the reconnoitering forces.

The question that one must ask himself upon encountering an enemy scouting line or screen is: What effect would the presence of the enemy main body in rear of this line have on the plans of my commander-in-chief?

If the answer to this question indicates a marked departure from the present strategical disposition such sacrifice as is necessary must be made to gain the information.

If the answer to the question indicates that no change would be made in the present disposition, then sacrificing ships to gain the information cannot be justified.

A commander of a group of scouts must have a thorough understanding of the general situation. There is a tendency to forget the general situation in the contemplation of the local one. Especially is this true when in contact with the enemy. The commander-in-chief often fails to receive valuable information because of the pre-occupation of scout commanders in the local situation.

A scouting force commander must be able to decide quickly and with good judgment. He must not fear responsibility and must at all times be ready to sacrifice such of his force as may be necessary to gain the desired information *in time*.

Energy, determination and an "infinite capacity for taking pains" are necessary characteristics of a successful scout commander.

In the words of Clausewitz: "Information is the foundation of all our ideas and actions."

STRATEGICAL SCOUTING.

The second phase of scouting operations, "Strategical Scouting," commences with the location of the enemy main body and continues until the forces are within striking distance. It may last for days, or, if the forces are close when discovered, it may not exist at all.

Scouting operations during this phase assume a new form. The area of profitable employment of the scouting force becomes restricted. Most of the ships that have been employed on search duty lie well outside this area. At least one night's steaming will be required before many of these ships can be of service.

The object of strategical scouting is to obtain information of the enemy upon which the commander-in-chief is to base his strategical operations. The chief points to be determined are: Enemy location, approximate strength, direction of movement, presence or absence of train or destroyers.

With modern naval forces it may be assumed that the portion of the reconnoitering force maintained near the main body for defensive screening will be stronger than that portion of the scouting force making the first contact with the main body.

Under these conditions it is reasonable to suppose that not more than one contact will be made until a considerable concentration of the scouting force has been effected.

When the opposing forces are separated so widely that no engagement can take place during the daylight of discovery or during the succeeding darkness, continuous tracking should be attempted only if no opposition is encountered.

If opposition is encountered, attempts at continuous tracking or even to make further contacts before a considerable concentration of the scouting force has been effected might, and probably would, result in a loss incommensurate with the value of the information gained.

If the first contact is made in the morning a sufficient force may possibly be concentrated by late afternoon to attempt a second contact. This contact should only be made, if possible to do so without undue risk. If the first contact is made in the afternoon no further contact should be attempted until the following daylight, unless no resistance is encountered during such observation.

The radio signal reporting the discovery of the enemy main body with the time of sighting, location, enemy's estimated course and speed, should be sent broadcast and relayed to all ships of the scouting force.

Unless acting under special instructions all searching ships should, upon receipt of this message, change course towards such reported location and increase speed to the maximum, consistent with the logistic condition presented.

The commander-in-chief, or scouting force commander, if there be one, should be immediately informed of the location of each ship of the scouting force and of her anticipated plan of action.

The first report to the commander-in-chief should, if possible, contain additional information of the enemy's approximate strength, presence or absence of train and destroyers.

Such of the scouting force of the interposing fleet as can reach the required positions should, during the night succeeding the first contact, be formed on an arc of a circle covering the courses assumed as probable for the enemy. The center of this arc is the enemy main body's latest reported position, and its radius the distance the enemy could steam at his assumed maximum speed from the time at which he was in this reported position until the following daylight.

The spacing of the scouts on this arc varies with the number of ships available, the strength of the enemy screen and the probable accuracy of the assumptions as to the enemy's course. The location of the enemy at daylight is of great importance.

In strategical scouting the hydroplane may play the decisive rôle. To drive all reconnoitering forces outside the limit of operations of an hydroplane would require a screen of great size and strength. Efficient hydroplanes may make it possible to obtain the desired information without risking valuable ships.

The efficiency of the hydroplane in moderate winds and seas is questionable and until further experiments are made the hydroplane must be considered only as a valuable aid and in no sense a substitute for scouting ships.

In general it may be said that during strategical scouting the interval of time elapsing between contacts depends upon the distance that separates the main forces or one main force and the opposing destroyers. If the distance is great, one contact in each daylight may be sufficient. As the forces approach the time intervals between contacts should decrease until strategical scouting merges into tactical scouting.

TACTICAL SCOUTING.

Tactical scouting comprises operations of the reconnoitering forces after the main forces are within striking distance. It has three phases:

(1) The destroyers of one force in striking distance of the other main body.

(2) The destroyers of each force in striking distance of the opposing main body.

(3) Both the main body and destroyers within striking distance of the similar forces of the enemy.

The relative position is of no value unless sufficient information is obtained to enable a force to profit by its position.

A force acting on the strategical defensive should plan its operations so as to make a destroyer attack upon the enemy before engaging in daylight action. The moral effect of a destroyer night attack, with torpedoes and floating mines, upon a fleet accompanied by a train will be great without a doubt. We must remember, however, that it will be next to impossible to make such an attack without the enemy acting similarly, for the absence of one's reconnoitering force in contact with the enemy will probably so reduce one's screening force as to make the denial of information impossible.

The moment a fleet accompanied by a train becomes convinced of its inability to avoid detection it will take the offensive with its destroyers at least.

To follow a night torpedo attack by a major engagement at daylight is practically impossible without subjecting one's own main body to an attack by the enemy destroyers. Success in such an operation must be more or less luck, unless the enemy's scouting forces have been destroyed or they have lost their mobility due to consumption of fuel, break-down, or injuries received in previous engagements.

It would appear that in future when two modern fleets are approaching to engage each will be subjected to a destroyer attack during at least one night previous to the main engagement.

The destroyers can be led to their prey only by an efficient scouting force. The information must be as exact as it is possible to obtain. From the time that the destroyers are within striking distance information must be as nearly continuous as possible. During this period information must be obtained even at the sacrifice of many of the scouting ships.

A successful destroyer attack will so reduce the enemy's morale that the actual reduction in strength will be much greater than that represented by the material loss.

In avoiding this attack mobility is the greatest factor, and thus the fleet accompanied by a train is at a serious disadvantage.

The attack can only be avoided by successful screening. An attack can only reach home as the result of successful scouting.

It is in this phase of the operations that the double duty of the reconnoitering forces becomes most pronounced. To protect one's self may require many ships. To keep in touch with the enemy will require many. The correct adjustment of the forces available to successfully accomplish both missions requires a master hand.

Information may be obtained by superior strength, stealth, superior speed or numbers.

In Strategical Scouting it is only necessary to develop the enemy at intervals, but in tactical scouting constant information is desired in order that the destroyers may attack as soon as possible after dark and may be fully aware of the formation of the enemy in order that they may attack the enemy's best ships.

Such constant information can only be obtained by fighting if the enemy fleet is properly screened, unless by use of the hydroplane or submersible.

This is the ideal moment for hydroplanes or submersible scouts. Practically invulnerable, either type should be able to obtain the required information with ease unless the defensive screen is of immense proportions. To maintain a screen of such size would require so much of the reconnoitering force as to greatly reduce the force assigned to the offensive rôle or would reduce the strength of the screen to such an extent as to make it vulnerable to ships.

To follow a night attack by a major engagement is in every respect desirable, but as has been pointed out such close approach of the main body brings it within the danger area of the enemy destroyers. To obtain the closest approach to the ideal it is necessary to afford our fleet such protection against torpedoes as will permit us to exchange destroyer attacks with the enemy confident in the knowledge that our destroyers can do more damage to the enemy than his destroyers can do to us.

Tactical scouting previous to a major action in daylight can only be effected by ships faster than any stronger ship in the enemy's fleet, until the hydroplane and submersible have been developed for this purpose.

Such information as can be obtained will be of great value to the commander-in-chief in making his tactical dispositions.

To be of value the information must be accurate, definite and continuous. It must not be delayed in transmission. It should

include the enemy's strength, formation, disposition of destroyers, submersibles and train, approximate speed and course.

SCREENING.

In the discussion of types of naval campaigns in previous pages, an attempt was made to show that under usual conditions in oversea campaigns the reconnoitering force of one fleet is acting aggressively in the quest for information, while the reconnoitering force of the other fleet is attempting to deny information.

It has also been pointed out that exceptions will be found in cases where the fleet seeking a geographical objective is so superior that an engagement, even in the presence of its train, is desired, or when evasion having failed, a fleet so acting decides to take the tactical offensive, perhaps only with its destroyers, in order to prevent being brought to action in the presence of its train.

Assuming that the main forces and destroyer flotillas are of nearly equal power, it seems evident that the force acting on the strategical offensive in an oversea campaign will endeavor to avoid action until a temporary base has been established and its train deposited in safety. If this assumption is correct we should be able to decide upon the course of action to be followed by the reconnoitering force of such fleet in order to afford the greatest aid to its main body and train in the attempted evasion.

Successful evasion by the main body may be accomplished by (1) Approaching the strategical objective by a route which it is hoped is not being searched by the enemy reconnoitering force. (2) Deceiving the enemy reconnoitering force. (3) Destroying the enemy reconnoitering force.

The first method might be successful, but such success would probably be accidental, for the limits of courses possible to ships whose speeds and radii of action are known, can be closely approximated.

The range of visibility of a modern fleet and train comprising probably more than one hundred vessels, is very great but even this will be increased by the size of the defensive screen which must always surround such a fleet to secure it from surprise and observation.

The first method is the only one an example of which is afforded by history—the Russian battle fleet en route east, but in this case the accompanying reconnoitering force was so small, and the radio

so inefficient, that no attempt was made to maintain a proper defensive screen.

An attempt to evade an enemy by this method is, and can only be, justified when the reconnoitering force of such fleet is so small or inefficient as to be only sufficient for a defensive screen.

The second method, "Deceiving the enemy reconnoitering force," may be advantageous if the deception of such force for one day may afford the main body a chance for evasion.

This method is accomplished by forming a false screen at some distance from the main body and so directing its course and speed as to effect contact with the enemy reconnoitering forces before the main body makes a contact, and in such position relative to the main body that a concentration of the searching force to develop the false screen may afford the main body a chance to avoid detection.

The false screen must have sufficient force to deny information of what lies within until the searching force shall have concentrated a strong force to break the screen. This screening force should take the tactical offensive at every opportunity in order to defeat the searching force in detail. Such a screen should be composed of strong, fast vessels that may avoid all ships which are superior in power, and may, when their deception is discovered, rejoin their own main body with greater speed than is available to the searching force.

As a rule strategic movements cannot be concealed from an enemy by this method, for the possibilities of rapid communication by radio and cable permit of news from secret agents in neutral ports and on neutral ships being received with little delay.

Such a screen might deceive an enemy for a day or two and might cause a concentration of the searching force, thus leaving a hole in the searching force through which the main body might pass.

Its principal effect would probably be a moral one upon the enemy commander-in-chief. Colonel Furse says: "Indecision in a commander may not be part of his nature, and often originates .... from the state of ignorance in which he is kept with regard to the action and intentions of his opponent. The heavy responsibilities which rest on him may therefore produce an amount of caution which is quite strange to his ordinary character."

If the first screen is developed and discovered to be false the commander-in-chief may hesitate to take immediate action when the real screen is reported.

It is evident that a reconnoitering force of some size is required for this method and the question as to its relative efficiency as a false screen or as a true offensive screen must be determined largely by the value of its possible success.

The third method, "Destroying the enemy reconnoitering force," is, if sufficient force is available, the most probable to meet with success. This method is the true offensive screening.

OFFENSIVE SCREENING.

In search operations the forces are advanced in the direction the commander-in-chief considers most probable to locate the enemy. This force must be well advanced in order to give the main body ample time to move to any portion of the theater of operations to interpose between the enemy and his proposed objective, after the desired information has been obtained.

The area to be searched is governed by information of the enemy received before actual contact is made.

In a large theater of operations the searching force must be widely dispersed to cover the possible directions of approach of the enemy.

In offensive screening the mission is the destruction of the enemy reconnoitering force. This force must be located before it can be attacked. The main strength of the screen should not, therefore, be widely separated from its main body until the enemy searching force is located by advanced scouts.

An advance by the screen in strength, previous to the location of the enemy searching force, might be but a blow in the air. If it failed to find the enemy searching force it might continue the advance in the wrong direction, thereby affording the searching force the opportunity of locating the main body without opposition. The enemy scouting line must be first located by advanced scouts.

The advanced scouts having located the enemy scouting line, the screen should advance to engage. A greatly superior strength should be brought into each action, if possible. The ideal is to be so superior as to crush the opposing ships without sustaining any damage. This can hardly be hoped for but as has been pointed

out, successful search requires dispersion, successful screening concentration. If, therefore, the ships of the screen are fast enough to act together in overpowering enemy scouts some concentration should always be possible.

The loss or injury of a ship is a greater disadvantage to the searching force for the area assigned to the injured ship must be left unsearched or other ships must increase their areas, thus decreasing the efficiency of their search.

Every victory will increase one's morale and will decrease that of the enemy. The loss of any ship in the searching force will cause a wider dispersion of the remaining force. If evasion by the main body becomes impossible and offensive action is decided upon these successful engagements will have greatly facilitated one's own scouting operations.

The advanced scouts must be faster than any ships of the enemy searching force if possible. In fact successful screening requires ships that are faster than the ships of the searching force and of equal or greater strength. The screen must be faster than any force of superior strength that the enemy might send against it.

DEFENSIVE SCREEN.

In the general discussion of screening it was pointed out that a defensive screen, used alone, can only be justified when the reconnoitering force accompanying the fleet is very small, weak or inefficient.

The surest way to escape detection is to destroy the enemy searching force by an offensive screen. The complete destruction of the enemy searching force is, however, an ideal conception and its accomplishment very improbable.

The development of the automobile torpedo carried in destroyers, which are becoming faster and more able to undertake distant operations each year, has made it necessary to maintain with each main body a force sufficiently fast and strong to prevent enemy ships from locating and observing the main body during daylight and of giving information of the approach of hostile ships at night.

The offensive screen or the scouting lines provide a measure of security but neither is necessarily sufficient to secure the main body against observation or destroyer attack. Each must there-

fore be supplemented by a special service of security near the main body.

This special service is called tactical or defensive screening. Its objects are (1) During daylight to prevent enemy vessels approaching within sighting distance of the smoke of the main body. (2) To give ample warning of the approach of any force of superior power in order that support may be sent in time to prevent such enemy force gaining information of the main body.

During darkness.—(1) To warn the main force of the approach of enemy destroyers or major ships.

(2) To aid in the destruction of any attacking destroyers.

From the nature of the two duties enumerated it will be clear that the performance of both duties by the same force is impracticable.

The tactical or defensive screen is formed by surrounding the main body by a screen of ships through which an enemy must break to gain information and through which he must pass a second time to escape.

A screen of this nature should surround any large fleet, especially at night. It must, however, be much stronger if it is the only protection, that is, if no scouting force or offensive screen has previously cleared the area.

In order to deny information to the enemy the screen must be supported by a force superior to the support of the enemy scouting line. These supports must be placed at such a distance from the main body that they may intercept an advancing enemy before he has seen the main body smoke. It is evident that to accomplish this, the support must occupy a central position and must be warned of the enemy's approach by lookout or picket ships.

As this screen accompanies and surrounds the main body its formation must be simple and must vary greatly with the force available.

If the support is strong enough to defeat any probable reconnoitering force the enemy may send out, the area covered should be, during the day, the largest consistent with proper outposts and support. The screen would be preferably of such an extent that, if at dark no destroyers are within the screen the chance of a successful destroyer attack by the enemy will be small.

If the force is too weak to deny entrance to enemy reconnoitering ships the screen should be compact, merely large enough to give notice of the enemy main body approach in sufficient time to permit its own main body taking up battle formation before the enemy fleet can get within range.

The chance of getting home a successful night destroyer attack is dependent upon information of the position and movements of the enemy main body. A force constrained by paucity of numbers to assume a tactical screen yields this opportunity to the enemy.

This use of the scouting force is opposed to active reconnaissance and is almost useless in gaining information of the enemy. It is the service of security as its main objective is to prevent surprise.

To use the entire reconnoitering force as a defensive screen tends to destroy morale by placing the entire force in a defensive attitude. It should only be adopted when the force available is small and weak.

Its tactical composition is dependent on force available, enemy scouting force, enemy destroyers, radius of visibility, etc. "In principle this screen should—

(1) Be suited to existing or expected conditions.

(2) Be simple in formation.

(3) Consist of two lines, pickets and supports."

During daylight the ships of the screen should be spaced as far apart as is necessary to maintain a complete circle of observation around the main body at a distance exceeding the range of visibility by at least one hour's steaming distance. At intervals of thirty miles this would require twelve ships.

The distance of this screen would prevent its closing in to a station for night screening without confusion. If the change was made previous to dark the enemy vessels might follow to within observation distance unopposed.

The day screen is in itself a protection against night attack, for if the main body position is not determined during daylight it will be the merest chance if the enemy destroyers are successful in their search in the dark.

Such success remains a possibility, however, and in order to protect the fleet from surprise a screen should be formed around the fleet distant about ten thousand yards, by converted yachts,

revenue cutters, gunboats, tugs, or empty auxiliaries, if available.

The moral effect of a screen will be very beneficial to the main body, and the screen, while of not much intrinsic value, will confuse an attacking force and thus aid in saving the main body.

GENERAL.

This discussion of scouting and screening operations is now completed, but before closing a few of the principal points will be recalled.

In Searching.—Mission to gain information of enemy main body.

Decide upon area to search. Be careful not to search unprofitable area.

Decide upon method; maintain concentration; watch logistics.

Avoid engagements.

Remain in designated area until enemy main body is reported, then head for reported position at maximum speed.

In Strategical Scouting.—Locate enemy main body at intervals. Every twenty-four hours if very distant. Decrease intervals as distance between forces decreases.

When making contacts daily or twice a day use method of position circle.

In Tactical Scouting.—Gain information for use of the destroyers as often as necessary. Sacrifices must be made to gain sufficient information for successful destroyer attack.

In Offensive Screening.—Mission is the destruction of enemy searching force. Ships should take the tactical offensive unless very much inferior.

In Defensive Screening.—Mission is to prevent observation or surprise attack. Ships should take tactical offensive unless of inferior force.

No one, who has experienced the feeling of helplessness that comes over a commander who lacks information, can fail to appreciate Colonel Furse's saying, "In nothing more than in war knowledge is power."

ORDERS FOR A THEORETICAL CAMPAIGN.

The campaign orders in the following pages are given to show the statement of orders for several different methods of search and scouting.

The assumptions upon which the campaign is based are as follows:

(1) A Japanese squadron of six merchant scouts, speed 20 knots, is scouting between China and the Loo Choo Islands by the Out and In Method as indicated in Diagram 1.

(2) Three ships, speeds 20, 18, and 17 knots, are at the Bonin Islands as a flank guard.

(3) The Japanese main body and a squadron of six 18-knot cruisers are at Tsushima. The cruiser squadron is coaling and will not finish in time to leave before 4 a. m., 2 June.

(4) At 5 a. m., 1 June, the Russian fleet is sighted by Japanese lookouts (fishing vessels) passing through Ballintang Channel, heading to the eastward.

(5) This information is received by the commander of the merchant scout squadron by radio at 9 a. m., by the commander-in-chief at Tsushima at 4 p. m. Orders from the commander-in-chief are received by the force at Bonin Islands in time for them to sail at 10 p. m.

(6) The commander-in-chief's instructions are:

Merchant scouts search from line bearing 7° true from Lat. 19° 50′, Long. 122° 00′ to the eastward.

Cruiser squadron sail as soon as coaled and search for enemy's van to the westward of the Bonin Islands.

Flank guard search for the enemy's southern flank, from line bearing 110° true from Lat. 19° 50′, Long. 122° 00′.

(7) The commander of the merchant scout squadron assigns stations on a line bearing 7° true from Lat. 19° 50′, Long. 122° 00′ covering assumed speeds from twelve to seven knots. He informs his force that he will scout to a radius bearing 42° true from the above position, during the following daylight. Each ship will regulate speed to arrive at that radius at 7 p. m.

(8) The cruiser squadron proceeds at 4 a. m., 2 June. During the afternoon the commander issues his campaign order sending a copy to the merchant scout commander. The cruiser squadron will run a twelve knot search curve patrol during 3 June from Lat. 27° 30′, Long. 129° 30′.

(9) The flank guard commander directs his ships to search independently, each ship proceeding to the meeting point on the limiting line at maximum speed and then searching to the northward and eastward. The 20 knot ship will search on as-

sumed enemy speed of twelve knots, the 18-knot ship on 10-knot assumption and the 17-knot ship on 8 knot assumption.

(10) At dark, 2 June, the merchant scout commander having been informed of the intention of the cruiser squadron for 3 June, decides to concentrate his force more by reducing the difference in enemy's assumed maximum and minimum speeds. As the cruisers will cover the 12 knot assumption he decides to use assumed speeds of 11, 10.5, 10, 9.5, 9, 8.5 knots. He assigns these speeds to his vessels for the days of 3 and 4 June.

(11) During 4 June the cruiser squadron continues the patrol until 3.30 p. m., at which time they have arrived at the position desired for commencing the Out and In Method, and at that time this squadron changes courses simultaneously to 200° true.

(12) The ships of the flank guard have continued their independent search.

(13) At 3.30 p. m., 4 June, two merchant scouts sight a heavy smoke bearing to the southward and by 4.30 have reported the position of the enemy main body to all ships of the Japanese fleet.

(14) During this time the Japanese main body has been moved from off Tsushima to a point to the northward of the island of Amami-O-Sima and a radio chain has been established with the scouting detachments.

NOTE.—The speed and formation (cruising) considered in this diagram are those actually used by the Russian fleet on its passage from the Saddle Islands to Tsushima.

X fleet delayed several hours by accident to engines of one ship.

(15) A concentration of the scouting force is immediately started. The Japanese destroyers directed to proceed to attack. The main body moved to intercept the Russian fleet.

INFORMATION RADIOGRAM FROM MERCHANT SCOUT SQUADRON COMMANDER.

To Commander-in-Chief.

SOUTHERN SCOUTS,
HOGI MARU, FLAGSHIP.

LAT. TWENTY-SEVEN FIFTY, LONG. ONE TWENTY-FOUR FIFTY.
One June, nine a. m.

Enemy main body and train in BALLINTANG CHANNEL, one June, five a. m., heading eastward.

Southern scouts will scout to eastward from line bearing seven degrees true from Lat. nineteen fifty, Long. one twenty-one fifty, by retiring search sector method.

OKU.

RADIOGRAM TO SHIPS OF MERCHANT SCOUT SQUADRON.

To Squadron Five.

SOUTHERN SCOUTS,
HOGI MARU, FLAGSHIP.
LAT. TWENTY-SEVEN THIRTY, LONG. ONE TWENTY-FOUR FORTY.
One June, nine thirty a. m.

Enemy main body and train in BALLINTANG CHANNEL, one June, five a. m., heading eastward.

Squadron Five move towards Lat. twenty-three forty-five, Long. one twenty-two twenty. Speed eighteen knots.

OKU.

Rear Admiral Oku directs a general movement of his squadron towards the position he expects to occupy at daylight 2 June, but does not give his plan to his subordinates until it is approved by the commander-in-chief. His plan might not meet with the approval of the commander-in-chief, who must, in this case, direct the task of each scouting group in order to ensure the maximum efficiency and coordination. Rear Admiral Oku by directing a general movement of his squadron towards the enemy has given all the instructions required for the present and has avoided the possibility of having to countermand an order. Countermanded orders create confusion and lack of confidence in the superior.

The commander-in-chief upon receipt of Rear Admiral Oku's radiogram issues a combined order as follows:

Campaign Order
No. —.

JAPANESE IMPERIAL FLEET,
H. M. S. MAKASA, FLAGSHIP,
OFF TSUSHIMA.
One June, four, eleven a. m.

FORCES.

(a) Southern Scouts.
Rear Admiral Oku.
Squadron Five.

(b) Central Scouts.
Rear Admiral Nigi.
Squadron Three.

(c) Flank Guard.
Rear Admiral Suki.
Division Nine.

(d) Main Body.
Squadrons One and Two.
Destroyer Flotilla.

(e) Radio Chain.
Captain Fugi.
Division Eight.

1. Enemy main body and train in BALLINTANG CHANNEL, one June, five a. m., heading eastward.

2. This force will seek decisive engagement with enemy fleet.

3. (a) Southern Scouts search eastward from line bearing seven degrees true from Lat. nineteen fifty, Long. one twenty-one fifty.

(b) Central Scouts search for enemy's van to westward of BONIN ISLANDS.

(c) Flank Guard search northward from line bearing one ten degrees true from Lat. nineteen fifty, Long. one twenty-one fifty.

(d) Main Body will proceed at eight a. m. two June, towards position Lat. twenty-nine, Long. one thirty.

(e) Radio Chain maintain communication between scouting forces and main body.

4. Train remain at TSUSHIMA.

5. Use cipher "X" and one hundred and thirtieth meridian mean time. Makasa with main body.

TIGI,
Admiral, Commander-in-Chief.

Copies to Navy Department, Rear Admiral Oku, Rear Admiral Nigi, Rear Admiral Suki, Captain Fugi. By radio.

s —— Quill, Lieutenant, Radio Officer.

By this arrangement of the searching force, it will be noticed that the searching forces are, during the search, continually drawing together, thus concentrating as much as possible before the enemy is discovered.

Rear Admiral Oku receives this combined order at noon and issues the following campaign order:

SOUTHERN SCOUTS,
HOGI MARU, FLAGSHIP.
LAT. TWENTY-SIX, TWENTY-FIVE,
LONG. ONE TWENTY-FOUR, ZERO FIVE.
One June, four, one p. m.

Campaign Order No.—.

1. Enemy fleet and train in Lat. nineteen fifty, Long. one twenty-one fifty, at five a. m., one June.

Our main body will proceed at eight a. m., two June, towards Lat. twenty-nine, Long. one thirty. Squadron Three will search for enemy's van to westward of BONIN ISLANDS. Division Nine will search northward from line bearing one ten degrees true from enemy's five a. m. position. Division Eight will maintain radio communication.

2. This force will search for enemy main body.

3. Assume enemy speed in knots as follows:

(a) E-1, twelve.
(b) E-2, eleven.
(c) E-3, ten.
(d) Hogi Maru, nine.
(e) E-4, eight.
(f) E-5, seven.

(x) Be in position on line bearing seven degrees true from Lat. nineteen fifty, Long. one twenty-one fifty, and start searching to eastward at five a. m., two June. Use retiring search sector method. Sector for daylight two June, thirty-five degrees.

4. —

5. Use cipher "X" and one hundred and thirtieth meridian mean time.

OKU.
Rear Admiral, Commanding Southern Scouts.

Copies to Commander-in-Chief, Rear Admiral Nigi, Rear Admiral Suki, Commanding Officers, Squadron Five. By radio.

s ——, Lieut., Flag Secretary.

Upon receipt of Rear Admiral Oku's campaign order each ship of squadron five should change course and speed to arrive in position at the specified time. Each ship should report to the squadron commander the position he expects to occupy at 5 a. m., 2 June.

At 5 a. m., 2 June, each ship of this squadron should report her position to the squadron commander.

Rear Admiral Nigi commanding squadron three does not issue a campaign order at this time as his squadron cannot get underway before 4 a. m., 2 June. He signals "Be prepared to get underway at 4 a. m., 2 June. Speed, eighteen knots."

Before getting underway he should call his commanding officers on board and inform them of his general plan, but he should issue no campaign order for search operations at this time.

Rear Admiral Suki receives the commander-in-chief's combined order at 8 p. m., and immediately signals "Prepare to get underway at ten p. m. Maximum speed."

He then writes the following campaign order and, having called his commanding officers on board, delivers it in person.

FLANK GUARD,
H. M. S. F-1, FLAGSHIP,
BONIN ISLANDS.
One June, four, nine p. m.

Campaign Order
No. —.

1. Enemy main body and train in BALLINTANG CHANNEL, one June, five a. m.

Our main body will proceed at eight a. m., two June, towards Lat. twenty-nine, Long. one thirty. Squadron Three will search for enemy van west of BONIN ISLANDS. Squadron Five will search eastward from line bearing seven degrees true from enemy's five a. m. position. Division Eight will maintain radio communication between scouting force and main body.

2. This force will search for enemy main body.

3. Assume enemy speed in knots as follows:

(a) F-1, twelve.

(b) F-2, ten.

(c) F-3, eight.

(x) Search northward from line bearing one ten degrees true from Lat. nineteen fifty, Long. one twenty-one fifty. Use independent retiring search. Proceed at maximum speed when ready.

4. —

5. Use cipher "X" and one hundred and thirtieth meridian mean time.

SUKI.
Rear Admiral, Commanding Flank Guard.

Copies to Commander-in-Chief, Rear Admiral Oku, Rear Admiral Nigi. By radio. Commanding Officers, Division Nine, delivered on board.

s ——, Lieut., Flag Secretary.

During 2 June, squadron five is searching the area prescribed for the day. Division nine is steaming to the southwestward towards the meeting points on the prescribed line for commencing the search. The radio chain is moving eastward to maintain communication. Squadron three finishes coaling at 4 a. m. and sails from Tsushima in accordance with the combined order previously issued.

At 8 a. m., 2 June, the main body sails from Tsushima in accordance with the following campaign order which was issued on board the flagship on the evening of 1 June.

Campaign Order
No. —.

MAIN BODY,
H. M. S. MAKASA, FLAGSHIP,
OFF TSUSHIMA.
One June, four, eight p. m.

1. Enemy main body and train in BALLINTANG CHANNEL at five a. m., one June.

Squadron Three will search for enemy's van to westward of BONIN ISLANDS. Squadron Five will search eastward from line bearing seven degrees true from Lat. nineteen fifty, Long. one twenty-one fifty. Division Nine will search to northward from line bearing one ten true from same position. Division Eight will maintain radio communication.

2. This force will seek decisive engagement with enemy fleet.

3. (a) Squadron One.
(b) Squadron Two.
(c) Destroyer Flotilla.
(x) Be prepared to get underway at eight a. m., two June, speed twelve knots.

4. —

5. Use cipher "X" and one hundred and thirtieth meridian mean time.

TIGI,
Admiral, Commander-in-Chief.

Copies to Division Commanders and Commanding Officers, Squadrons One, Two and Destroyer Flotilla. By guard boat.
s ——, Lieut. Comdr., Flag Secretary.

Rear Admiral Nigi, in command of Squadron Three, finding he has ample time to reach his station to westward of the BONIN ISLANDS before the enemy could possibly arrive, decides to aid squadron five by running a search curve patrol during 3 June, assuming the enemy speed as twelve knots. He issues the following campaign order sending a copy to Rear Admiral Oku by radio for his information.

CENTRAL SCOUTS,
H. M. S. C-1, FLAGSHIP.
LAT. THIRTY-ONE TWENTY-FIVE,
LONG. ONE TWENTY-EIGHT, FORTY.
Two June, four, three p. m.

Campaign Order
No. —.

FORCES.
(a) C-1.
(b) C-2.
(c) C-3.
(d) C-4.
(e) C-5.
(f) C-6.

1. Enemy main body and train in BALLINTANG CHANNEL, one June, five a. m. No further news of enemy. Our main body sailed from TSUSHIMA at eight a. m., towards Lat. twenty-nine, Long. one thirty. Squadron Five is searching from line bearing seven degrees true from Lat. nineteen fifty, Long. one twenty-one fifty. Division Nine is searching to northward from line bearing one ten degrees true from same position. Division Eight is maintaining radio communication.

2. This force will search for enemy main body.

3. (x) Use retiring search curve patrol. Order of ships as per margin. Scouting distance thirty miles. Scouting speed eighteen knots. C-1 will leave point of origin, Lat. twenty-seven twenty, Long. one twenty-nine thirty, at five a. m., three June. Obtain scouting distance by that time.

4. —

5. Use cipher "X" and one hundred and thirtieth meridian mean time.

NIGI,
Rear Admiral, Commanding Central Scouts.

Copies to Commander-in-Chief, Rear Admiral Oku, Rear Admiral Suki, Commanding Officers, Squadron Three. By radio.

s ——, Lieut., Flag Secretary.

Rear Admiral Oku receives Rear Admiral Nigi's campaign order at 5 p. m., and upon plotting the track of squadron three for 3 June, finds that on 3 June it is not necessary for him to cover higher assumed enemy speeds than eleven knots. He decides to use the retiring search sector method for 3 June, covering enemy assumed speeds from eleven to eight and a half. At 6 p. m. he issues the following campaign order.

SOUTHERN SCOUTS,
HOGI MARU, FLAGSHIP.
LAT. TWENTY-FOUR TWENTY-FIVE,
LONG. ONE TWENTY-EIGHT FIFTY-FIVE.
Two June, four, six p. m.

Campaign Order
No. —.

1. No further news of enemy. Our main body proceeding towards Lat. twenty-nine, Long. one-thirty. Squadron Three will on three June run a retiring search curve patrol from Lat. twenty-seven twenty, Long. one twenty-nine thirty. Assumed enemy speed twelve knots. Division Nine continuing search operations.

2. This force will continue search for enemy main body.

3. Assume enemy speed in knots as follows:
(a) E-1, eleven.
(b) E-2, ten and a half.
(c) E-3, ten.
(d) Hogi Maru, nine and a half.
(e) E-5, nine.
(f) E-6, eight and a half.
(x) Be in position on line bearing forty-two degrees true from Lat. nineteen fifty, Long. one twenty-one fifty, and start searching to eastward at five a. m., three June. Use retiring search sector method. Sector for daylight, three June, twenty-three degrees.

OKU,
Rear Admiral, Commanding Southern Scouts.

Copies to Commander-in-Chief, Rear Admiral Nigi, Rear Admiral Suki, Commanding Officers, Squadron Five.
s ——, Lieut., Flag Secretary.

Division nine continues its independent search. This division is outside of radio communication at dark 2 June, so makes no report.

At 5 p. m., 3 June, Rear Admiral Nigi sends a radio to his squadron as follows: "Retire at seven p. m. Course sixty true, speed twelve knots." At 7 p. m. he issues the following campaign order.

CENTRAL SCOUTS,
H. M. S. C-1, FLAGSHIP.
Campaign Order No. —.
LAT. TWENTY-SIX THIRTY-FIVE,
LONG. ONE THIRTY-FOUR FORTY-FIVE.
Three June, four, seven p. m.

1. No further news of enemy.
Our main body is in Lat. twenty-nine, Long. one thirty. Search operations continue.
2. This force will continue search for enemy main body.
3. (x) Retain present order of ships. At five a. m. four June continue search curve patrol. Enemy assumed speed twelve knots, speed eighteen knots. After daylight increase distance to forty miles.

NIGI,
Rear Admiral, Commanding Central Scouts.

Copies to Commander-in-Chief, Rear Admiral Oku, Rear Admiral Suki, Commanding Officers, Squadron Three. By radio.
s ——, Lieut., Flag Secretary.

Rear Admiral Oku, commanding southern scouts, signals by radio: "Retire at seven p. m. Course sixty-five true, speed twelve knots," and at 7 p. m. issues the following campaign order:

SOUTHERN SCOUTS,
HOGI MARU, FLAGSHIP.
LAT. TWENTY-FIVE ZERO FIVE,
LONG. ONE THIRTY-FOUR FIFTY-THREE.
Three June, four, seven p. m.

Campaign Order
No. —.

1. No further news of enemy.

Our main body is in Lat. twenty-nine, Long. one thirty. Search operations continue.

2. This force will continue search for enemy main body.

3. Assume enemy speed in knots as follows:

(a) E-1, eleven.
(b) E-2, ten and a half.
(c) E-3, ten.
(d) Hogi Maru, nine and a half.
(e) E-4, nine.
(f) E-5, eight and a half.

(x) Be in position on line bearing sixty-five true from Lat. nineteen, fifty, Long. one twenty-one fifty, and start searching to southeastward at five a. m. four June. Use retiring search sector method, sector for daylight four June, sixteen degrees.

OKU,
Rear Admiral, Commanding Southern Scouts.

Copies to Commander-in-Chief, Rear Admiral Nigi, Rear Admiral Suki, Commanding Officers, Squadron Five. By radio.
s ——, Lieut., Flag Secretary.

During 4 June, the western ships of the merchant cruiser squadron (squadron five) sight and report the enemy fleet.

"Enemy fleet and train, weakly screened, in Lat. twenty-seven thirty, Long. one thirty-six, at four-thirty p. m., four June. Heading to eastward. Estimated speed nine knots. Destroyers present."

OKU.

Upon receipt of this message the commander-in-chief issues the following campaign orders:

JAPANESE IMPERIAL FLEET,
H. M. S. MAKASA, FLAGSHIP.
OFF OMAMI-O-SIMA.
Four June, four, six-thirty p. m.

Campaign Order
No. —.

FORCES

(a) Scouting Force.
Rear Admiral Nigi.
Squadrons Three and Five, Division Nine.
(b) Destroyer Flotilla.
(c) Main body.
(d) Radio Chain.

1. Enemy main body and train weakly screened, in Lat. twenty-seven thirty, Long. one thirty-six at four-thirty p. m., four June. Heading to eastward, estimated speed nine knots.

2. This force will seek a decisive engagement with enemy main body.

3. (a) Scouting force observe enemy main body.

(b) Destroyer Flotilla proceed at increased speed and attack enemy main body during darkness, at first favorable opportunity.

(c) Main Body will steam at maximum speed to intercept enemy main body.

(d) Radio chain maintain communication between scouting force and main body.

4. —

5. Makasa will be with main body. Use one hundred and fortieth meridian mean time, cipher "C."

TIGI,
Admiral, Commander-in-Chief.

Copies to Navy Department, Rear Admirals Nigi, Suki, Oku, Captain Tugi. By radio.
s —, Quill, Lieut., Radio Officer.

Upon receipt of this campaign order and position reports from all ships of the scouting force, Rear-Admiral Nigi issues the following campaign order.

SCOUTING FORCE,
H. M. S. C., FLAGSHIP.
LAT. THIRTY-ONE,
LONG. ONE FORTY.
Four June, four, eight p. m.

Campaign Order
No. —.

1. Enemy main body and train weakly screened in Lat. twenty-seven thirty, Long. one thirty-six at four-thirty p. m., four June, heading eastward, estimated speed nine knots. Our main body moving to intercept enemy. Destroyer Flotilla proceeding at increased speed to attack. Division Eight maintaining radio communication.

2. This force will locate and observe enemy main body.

3. (a) C-1 Lat. twenty-seven fifty, Long. one thirty-eight zero five.

(b) C-2 Lat. twenty-eight twenty-five, Long. one thirty-seven fifty.

(c) C-3 Lat. twenty-eight forty-five, Long. one thirty-seven twenty-five.

(d) C-4 Lat. twenty-nine zero five, Long. one thirty-six fifty-five.

(e) C-5 Lat. twenty-nine twenty, Long. one thirty-six fifteen.

(f) C-6 Lat. twenty-nine twenty-five, Long. one thirty-five forty.

(g) E-1 Lat. twenty-six twenty, Long. one thirty-seven fifty-five.

(h) E-2 Lat. twenty-six zero, Long. one thirty-seven thirty-five.

(i) E-3 Lat. twenty-five twenty, Long. one thirty-six thirty-five.

(j) Hogi Maru Lat. twenty-eight fifty-five, Long. one thirty-four thirty.

(k) E-4 Lat. twenty-eight zero five, Long. one thirty-three fifteen.

(l) E-5 Lat. twenty-seven, Long. one thirty-three zero five.

(m) F-1 Lat. twenty-seven twenty-five, Long. one thirty-eight fifteen.

(n) F-2 Lat. twenty-six fifty-five, Long. one thirty-eight ten.

(o) F-3 Lat. twenty-five twenty, Long. one thirty-five twenty-five.

(x) Be in positions assigned and start scouting at five a. m., five June.

Speed maximum, course towards Lat. twenty-four thirty-five, Long. one thirty-two zero five, except E-5 and F-3, which ships will run retiring search curve, assumed enemy speed twelve knots.

4. —

5. Use one hundred fortieth meridian mean time. Cipher "C."

NIGI,

Rear Admiral Commanding Scouting Force.

Copies to Commander-in-Chief, Commander Squadron Five, Commanders Divisions Seven and Nine.

Extracts to Commanding Officers concerned, Destroyer Flotilla Commander.

s ——, Quill, Lieut., Radio Officer.

* The enemy fleet is sighted at 6.30 a. m., 5 June, and upon receiving the reported position, course and speed of the enemy, the scouting force concentrates for tactical scouting without further orders as shown in diagram 13.

* Diagram 12 shows movement of forces during the night of 4-5 June, in accordance with above orders.

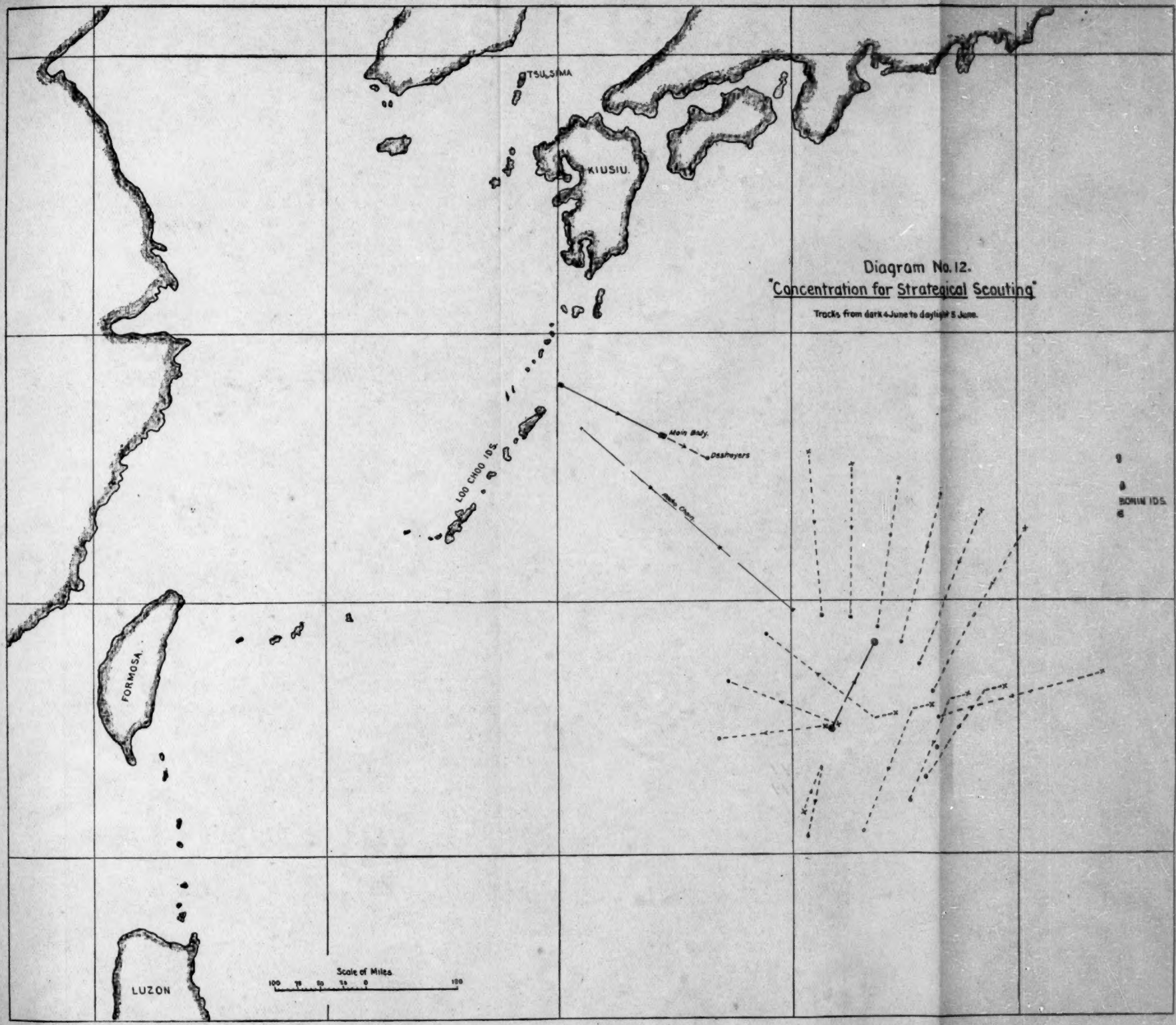


Diagram No. 12.
"Concentration for Strategical Scouting"
Tracks from dark 4 June to daylight 5 June.

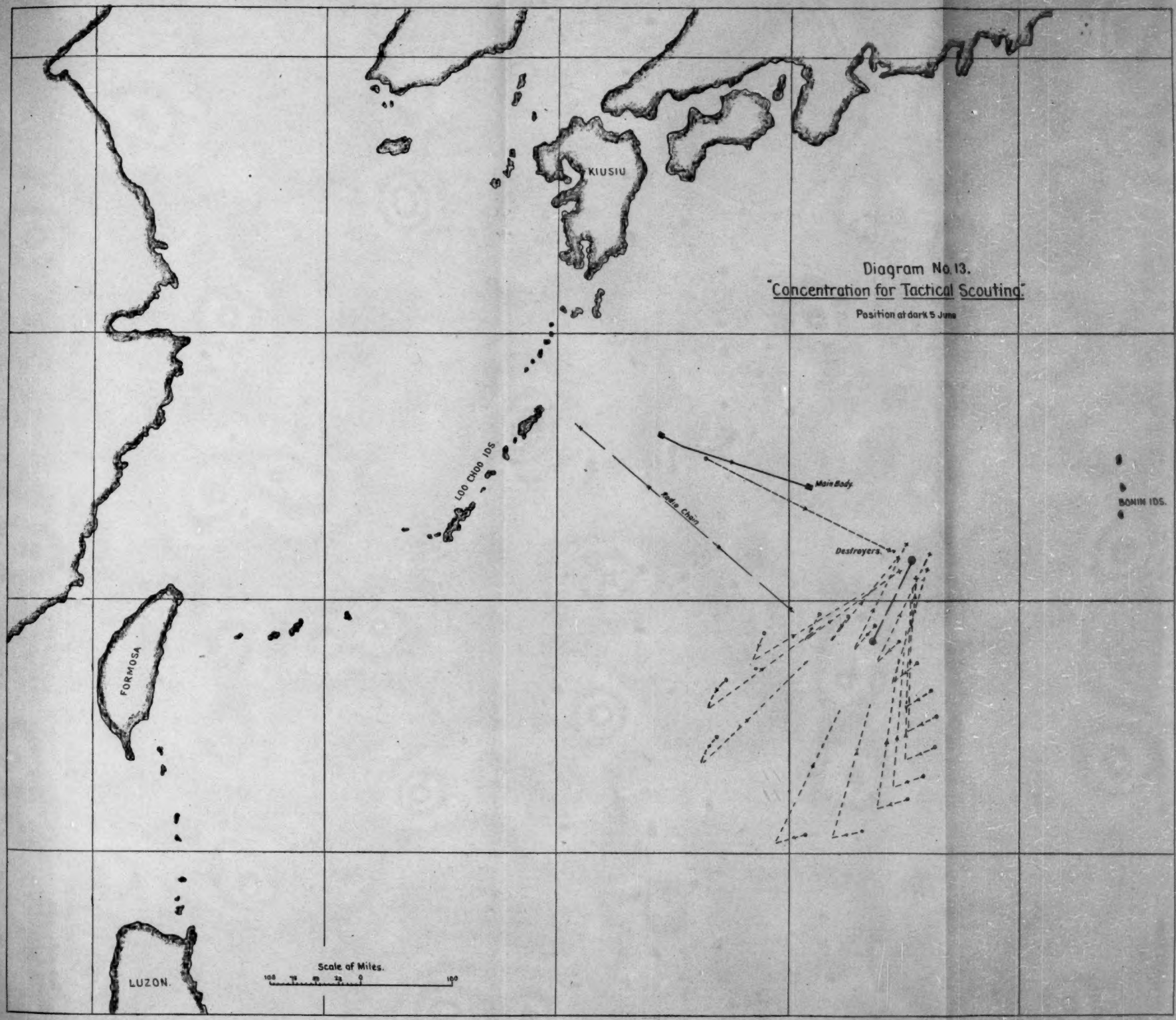


Diagram No. 13.

"Concentration for Tactical Scouting."

Position at dark 5 June

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TRADITION AND PROGRESS IN THE NAVY.

A REVIEW OF SERVICE OPINIONS. 1841-1901.

By CAPTAIN CARLOS GILMAN CALKINS, U. S. Navy.

No historical retrospect of the views of naval officers in the last century can afford technical instruction to their successors. Method as well as material has been transformed; research and experiment are recognized as the basis of improvement, and tradition is not so apt to be urged as a substitute for exact knowledge. It is admitted that the qualifications of an expert are independent of relative rank, and that nothing can be settled by citing the obsolete views of unqualified persons. Yet an exhibit from the past may demonstrate the necessity of drawing from naval officers a definite and rational opinion concerning service problems; and the record of an officer may include tests to disclose his capacity for performing this essential part of his duty, though this will require earnest co-operation between the educational institutions of the service and the fleet. Tradition is to be respected in so far as it sustains the *morale* and discipline of the service; but technical progress must seek elsewhere for its motive force, and accept nothing as a finality.

In his Washington address of January 13, 1913, Captain W. S. Sims, who has rescued our target practice from the trammels of self-complacent conservatism by constructive effort, spoke of "the dangerous self-deception caused by the service's disposition to resist criticism, to boast of our achievements and to minimize our defects"; and it may be worth while to show what lame and impotent conclusions have been due to such tendencies in the past. Moreover, Bacon has warned us that "The stubborn retention of customs is a turbulent thing, not less than the introduction of

new"; and it will not be found that conservatism, taking that word in its proper sense instead of that bestowed upon it by journalists, is more moderate or prudent than the tendency toward innovation and improvement. The habit of opposing practice to theory in technical discussion, which often means wilful blindness to the results of experiment, is characteristic of the sort of conservatism which deserves criticism; and it has not been altogether unknown in any of the world's navies.

The 60 years covered by this paper include a series of mechanical inventions which have transformed every branch of the naval and military service to such an extent that any surviving doctrine relating to these professions has to justify its existence by argument. Strategy may still borrow from the past, but tactics can by no means allow itself to be shaped by obsolete ideas and weapons. Up to 1841 this necessary readjustment was hardly recognized, and it is doubtful whether it would have been admitted by the Board of Navy Commissioners which had to surrender its authority in that year. Steam and shell-guns were ready for use, but their value could hardly be appreciated until a new system of education should have prepared the rising generation of naval officers for their work. Members of the famous class of 1841 were called upon to solve many problems during the Civil War; though part of the material available in 1861 indicated no progress since the days of Nelson or Decatur, the contest did not terminate until the necessity of mounting heavy guns in mastless ironclads had been demonstrated. Yet service opinion halted over the question of rifled ordnance and iron hulls for another generation, and the reasons for this check to progress manifestly deserve consideration.

One distinguished member of the class of midshipmen which entered in 1841 has contributed to the PROCEEDINGS OF THE NAVAL INSTITUTE since 1910; and the Seamanship compiled by Admiral Luce at the middle of his active career was enabled by partial revisions to serve as a text book for tractable midshipmen to the end of the century. Thus we find the name of a surviving officer recorded throughout the annals of the period under discussion and attached to works dealing with several of its problems.

The sources from which a review of service opinion are less numerous and accessible than might be supposed. Naval officers were rarely articulate during periods of stagnation, and the earlier

romanticism, as expressed in letters to the newspapers concerning conflicts of authority or questions of personal honor, has no practical significance. Official reports are sometimes controversial, but they rarely deal with technical subjects in a broad, impersonal manner. The pamphlets which followed the drastic sessions of the retiring board of 1855 deal only in personalities, and the service journals have preferred such topics to the more recondite lines of professional research. The Naval Institute, founded after the middle of our period, has done more to advance naval progress than any of the contempory publishers. Its contributors have belonged, for the most part, to the progressive wing of the service, every contribution testifying to some degree of mental activity; but its writers have not been free to criticize official decrees; and the antiquarian or historical tendency noticeable from the first has been confirmed by the fact that the elder essayists find themselves unable to take part in the discussion of the newer machinery. No modern writer on naval tactics would encumber his pages with a study of the galley period, and the manœuvers of a sailing fleet have also lost their place in professional education.

This inquiry does not undertake to deal with the problems of naval education or administration, and so has to put aside some of the most voluminous Congressional documents, as well as many interesting papers published by the Naval Institute. Still less is there any purpose of dragging in political discussions. These were tolerated in some of the published reports from military and naval officers before the Civil War, but the ablest pleas for the navy in the series of 1851—DuPont and Maury, for example—disclosed no partisan affiliations, though they were less discreet in regard to foreign affairs. Even economic questions of the day can be discussed without partisanship, as appears from the papers printed in the PROCEEDINGS 30 years ago, when the mercantile marine was the subject proposed for the prize-essay competition. A recent prize-essayist has chosen the same topic and developed it on lines of argument supplied by a merchant marine league founded by the late Senator Hanna, and these include the myth of "British gold" and other devices of the votaries of protection. The detached and dispassionate inquirer is fortunately on safer ground.

NATIONAL DEFENSE AND NAVAL PROGRAMMES.

Throughout the last century the champions of naval progress had to meet an effective opposition based on the project of 1816, by which the coast was to be guarded by fortifications alone, without strategic support from any mobile forces, either afloat or ashore. The author of the plan appears to have been General Bernard, an engineer who had served in the campaigns of Napoleon; but it was applied and defended for nearly half a century by General J. G. Totten, an able advocate by no means disposed to welcome progress in any branch of the public service. He did not shrink from high figures: 100 forts would be needed between Maine and the Mississippi, and a proportionate allowance was made in due course for Texas, Oregon, and California when these regions were annexed. The Great Lakes and the northern frontier were likewise to be guarded. Fortifications were relied upon to close all important harbors, to cover navy-yards, to deprive an enemy of bases of operations on our coast, to prevent the blockade of lines of interior communication, and to protect coastwise and interior navigation through bays and inlets. All this was to be accomplished by forts placed and armed to serve as barriers at the entrance of harbors; they were not to be equipped to stand a siege, and their batteries could not command a channel more than a mile in width. According to the estimate of 1851, 12,685 guns were required for the forts of the Atlantic and the Gulf; about half of these were actually mounted, including 4173 32-pounders and 1085 24-pounders; and heavier batteries for the new works are not specified, though it was probably intended to increase the number of 10-inch columbiads and mortars already installed. Fort Adams, at Newport, was to mount 464 guns; Fort Warren, at Boston, 334; Fort Schuyler was to guard the East River with 318, and 298 were to be marooned on the Dry Tortugas. The garrisons in war were to furnish about five men to a gun, amounting to 62,300 in all; but these would replace so many more troops that would be required while the harbors were left unfortified that the cost of fortifications would be balanced during a brief defensive or expectant campaign. This argument against raising an army when invasion was expected was not repeated after 1840, the report of 1851 having to deal with certain pleas put forward by advocates of the navy as an armament for defending the coast.

A notable feature of the military doctrine was founded on a comparison between the cost of repairs for the fleet and that of maintaining forts "that will last and be available for centuries." This calculation allowed no armament or design to be accounted obsolete while cast-iron and masonry endured. Thus, Fort Severn at Annapolis was credited with its 14 guns, for which a detail of 60 men was required, and funds were asked for its completion in the report of 1851, which classed it among the efficient batteries.

The first notable critics of the plan of fortifications of 1816 were connected with the military establishment. General Lewis Cass, Secretary of War in 1836, denounced "the project of endeavoring to render our coast impervious to attack" as impracticable, and he urged "the maintenance of a fleet competent to meet any hostile squadrons that might be detached to our seas." He proposed to build floating batteries, propelled by steam and armed with heavy guns; "being transferable defenses, they can be united upon any point, and a few of them be thus enabled to protect various places." Holding that "our first and best fortification is the Navy," the Secretary urged naval preparations limited only by regard to the public revenues and the progress of other maritime nations, and these views were approved by President Jackson, though they were directly opposite to the conclusions of the board of engineers which reported in 1836.

The Navy Commissioners did not engage in the controversy, but they allowed the publication of a report from Lieutenant L. M. Powell, U. S. N., who appended to his remarks on the survey of the coast of Florida an eager plea for naval development as a means of defending the coast. In comparison with the 116 forts in which garrisons were to be distributed to await attack, Powell urged the advantages of a force that could transport men, artillery, and supplies to any scene of action along the coast. A fleet, moreover, stood ready to "resent insult and punish aggression" in any part of the world; and "the protection of commerce and the prevention of tedious negotiations" were a part of its natural functions. Against a force which could, as this "blue-water" champion argued, "secure our commerce in the peaceful transit of the sea and resist the restrictions imposed by our commercial rivals," the proposed "system of empty fortifications, inert and lifeless until awakened by the broadsides of an enemy," made a poor

showing. Powell carried the quarrel into his military opponents' country by asserting that the system of 1816 had "wasted resources which would have been turned to the support of an efficient army; would have nurtured the military spirit of our people devoted to arms; would have sustained its discipline by keeping it embodied"; and this may have suggested the abandonment of the plea that fortifications made it unnecessary to levy troops to take the field during a war. The "Apalachicola document," as its critics called it without disclosing the name of its author, was uncompromising enough to insist that whatever policy of national defense we may adopt "must and ought to be pretty nearly exclusive in its application," while demanding the increase of the navy.

Such a document could not be altogether ignored, and Lieutenant H. W. Halleck, the strategist whom the War Department detailed as a sort of chief of the staff during the Civil War, undertook to support Totten and the board of engineers by a paper twice as long as that of Powell and by no means as original. Both writers appealed to history; but as they cited secondary historians of slight authority, their contradictions had little practical significance. Colonel Totten signed a further report in 1840 which opened with a serious criticism of the dangerous doctrine set forth by General Cass in 1836. Insisting upon "a complete independence of arrangement at every point" of the coast line to be defended and ignoring the capacities of a "fleet in being," it was shown that defense by gunboats or floating batteries had "the same intrinsic fault that an inactive defense by the navy proper has: . . . . the necessity of having an aggregate force as many times larger than that disposable by the enemy as we have important places to guard." All sorts of numerical comparisons were adduced to support this dogma, which, though it dates from 1840, has been employed by at least one officer still in active command in the army, and a force equivalent to 200 ships of the line was said to be the least that could be considered adequate for defending the Atlantic and Gulf coasts; "for it will be hardly contended that these defenses can be transported from one place to another as they may be respectively in danger." Steam would not help the defense, since the assailant could also employ it; and floating batteries would be driven from their positions by mortars mounted in bomb-ketches, with which the enemy was sure to provide him-

self. The navy was expected to limit its service in war-time to protecting our commerce and raiding unguarded harbors on the enemy's shores.

The Navy Commissioners had little opportunity to reply to these arguments, and it may be doubted whether they had any definite strategic principle to oppose to them. When asked in 1836 to specify the force and expenditure required to make the navy respectable in time of war, they had made the number of seamen available the basis of their reckoning: taking a third of those in the American merchant marine, the navy would have crews numbering 30,000, enough for 15 ships-of-the-line, and 25 of each of the four minor classes of vessels, frigates, sloops, steamers, and smaller vessels. Timber and guns for 10 more ships-of-the-line and as many frigates should be accumulated. The completed navy would cost $30,315,000, 40 per cent of which was already provided. An allowance of $1,300,000 for the increase of the fleet would renovate the navy in 15 years and the estimates for construction and armament show that no tactical or strategical readjustment was contemplated. Steamers were to cost $225,000 each, as against $550,000 for a ship-of-the-line, and the figures for the battery were $45,000 and $3000, respectively. The new type was to be prepared to "defend our great estuaries, to aid in the operations of our other naval force, and in the concentration or movements of the military force." In short, they were to add to the functions of the Jeffersonian gunboats those of the navy-yard tugs of 1870 and those assigned to our torpedo-boats in 1898.

In 1840 the Navy Board had to deal with proposals for floating batteries and, though the decision against these auxiliaries allowed much to the advocates of the plan of fortifying the coast, the rudiments of strategy appear in the record. Recognizing the impracticability of securing all exposed points by this means, the commissioners urged the policy of extending those "movable defenses which can advantageously meet an enemy at the greatest distance from his meditated points of attack, or be soonest concentrated to retard his progress, or to repel him from our shores." This notion of concentrating a cruising fleet and defending a coast instead of a number of harbors was irreconcilable with the localized distribution of ships which Totten had set up as the only system of defense by naval means; and the latter theory should not

have survived the partial tests it received during the Civil War. Yet the report of the Endicott Board on Fortifications showed that it still had some hold on the minds of naval officers in 1886—as it had upon the newspapers and the coastwise population in 1898. In spite of their references to "steam and ordinary ships-of-war" and other cautious phrases, the members of the last Board of Navy Commissioners were bold enough to prefer a force that would be "active—aggressive if necessary," to batteries that must be "almost wholly passive and strictly defensive."

In 1851 Congress decided to inquire whether the system of 1816 required to be modified on account of certain modern improvements. Railways had been advocated for strategic reasons in 1836 by General Gaines, who had insisted upon their utility in providing for the concentration of troops at points threatened with invasion. The engineers had reported that his proposed lines would cost over $108,000,000 for 6310 miles, even if the plan were practicable. All the lines had been built, however, by 1851; but Totten still argued that, as his forts were not built to stand sieges, the concentration of troops need not be provided for, and he enumerated many places where no aid could be derived from railways. A question relating to the application of steam to vessels-of-war and recent improvements in projectiles offered no difficulty to the defender of the plan of fortifications; and he disposed of a third query, the terms of which seem to reflect his familiar views, by the same line of argument; shipping of all types was grouped with "other temporary substitutes for permanent defenses," and he was asked what reliance could be placed on them. Totten was sure that his forts were permanent and that all ships were vulnerable—steamers being exposed to ten times as many injuries as sailing-ships; and the use of shells being altogether adverse to the naval claims, he declined to limit the scope of his plan of fortification, which he was now prepared to extend to the Pacific coast. Totten's assurance of "the danger attending every form of defense by naval means, and the intolerable expense of a full provision of these means," grew from his doctrine that "the defensive force at each point deemed worthy of protection must be at least equal *in power* to the attacking force," and his formula for multiplying ships to meet this demand.

Naval officers were also invited to express an opinion upon the questions formulated by Congress in 1851, though not to comment

upon Totten's memorial. Commodore Charles Stewart, whose first commission dated from 1798, adopted the standpoint of the engineers, and argued that the use of steam required more forts, since ships could not be relied upon to guard the coast. Commander DuPont amplified the plea of the engineers and urged that the navy should make the protection of commerce its principal duty in war. The alternative policy would, he wrote, involve vast expense and the loss of the "skill, daring, and endurance which give to the seaman his power and prestige on the ocean." He thought it fortunate that our progress in building steamers had been slow, though he envied England her screw ships-of-the-line and regretted that Spain's steam navy was larger than ours; but he argued our position might be regained by building heavily armed ships with auxiliary engines. In words which might have been quoted against him in the controversy over the withdrawal of the monitors from the attack on Charleston in 1863, DuPont added that, "compared with a sailing-ship, a steamer has 20 mortal parts to one . . . . No ship or ships can lay under a fort at this day; no American fort at least, with its furnaces for hot shot in addition to these murderous shells."

Strategic principles appear in the answer of Commodore Charles Morris, who declined to recommend any type of vessels as "substitutes for fixed fortifications," but claimed that the fleet might help to defend the country by intercepting or diminishing the enemy's force at sea, or by compelling him to defend his own shores. Commodore M. C. Perry also urged that the navy might be our chief defense if given "strength sufficient to protect our commerce in every sea, and in time of war to assume the offensive." Yet he proposed the distribution of naval vessels, including steamers, rams, and floating-batteries, for harbor defense—a proposal concerning which DuPont had asked, in terms as pertinent in 1898 as in 1851, "And how would a naval force for home defense be partitioned out to the different cities and stations without endless vexation, dissatisfaction, and dispute?" Lieutenant Dahlgren actually offered a diagram showing how 10 ships of various types might be placed to oppose the advance of 20 steam frigates. As he allowed the forts an effective range short of 1800 yards, such auxiliaries were indispensable. Lieutenant Lanman urged the strategic employment of steamers and armed vessels towed by steamers to prevent invasion. The enemy would not

land close to a fort, and our fleet could baffle his attempt to land on unfortified beaches.

The most ardent champion of the navy as a factor in coast defense was Lieutenant Maury, the eminent hydrographer. His literary skill was remarkable, and his imaginative power even more so; he had mapped the telegraphic plateau for the Atlantic cable on the strength of a very few soundings; and his views in regard to the blockade of the Gulf coast were truly prophetic. Railways and telegraphs had made the system of 1816 obsolete for the Atlantic coast, and the completion of a transcontinental line at an early date would secure the Pacific states in the same fashion. The remaining function of the forts was "to protect our *seaport towns* from the great guns of big ships." The fact that the advocates of fortifications did not propose heavier batteries than 42-pounders was significant; and he denied that enough forts to guard the whole coast could ever be completed, though it was high time to thicken the parapets of existing works. Naval supremacy in our own waters was his maxim; the Gulf of Mexico required the presence of an active squadron to hold the enemy's forces in check. Otherwise the hostile fleet "could string itself at anchor along the coast, in sight of the very works built for defending it, and if our reliance were upon them, it might capture or dam up in stagnant ruin all the commerce of the Mississippi Valley." The hydrographer's hint about anchoring on the blockade may have been of use to his former comrades in later years, when Maury was in Europe trying to procure materials for defending the southern coast by mines and torpedo flotillas. The blockade was effective enough to prevent him from getting the supply of cotton with which payments were to be made and from shipping such gear as he could obtain to the ports where it was required. Even California might be starved into terms by a blockade unless the United States kept a squadron at San Francisco or built a railway to the Pacific, since the state did not produce breadstuffs for the population in 1851. Maury was not infallible, and some of his financial comparisons were as fallacious as those of the engineers. He allowed only $5,625,000 as the cost of a coast-guard of 25 steamers, capable of discomfiting the fleet of an invader. But his plans for scouting and concentrating our forces, both afloat and ashore, by the aid of lines of telegraph and railways show that he was not lacking in strategic ideas.

Fortifications were not altogether condemned in Maury's report: he would have barrier forts at the entrance of important harbors; and Key West and Dry Tortugas should be fortified to secure the Gulf of Mexico for our navy, upon which Panama, Nicaragua and Tehuantepec would impose new obligations. The existing works should be armed with improved heavy ordnance; and powerful guns should be so mounted that they could be shifted to earthworks for protecting minor harbors and outlying positions—a notably modern suggestion. The notion that none of the forts should be prepared for a siege by land, taken in connection with the proposal to leave forts in the hands of state or local authorities and volunteer garrisons, might be taken as indicating a disloyal foresight; but Maury's confidence in our free institutions as our best defense was sincere. Invasion was impracticable, he declared; "unlike Europe, there are no disaffected people in this country for a foe to tamper with. The government is by the people, for the people, and with the people. It is the people." An American expedition would, however, be welcomed by "the down-trodden millions" of the Old World. Guerrilla warfare would baffle an invader. "An enemy planting his foot upon our soil could at best hold no more of it than that upon which he actually stands and covers with his guns," an opinion which Maury might have remembered before he joined Maximilian in Mexico in 1866. Slavery was ignored in his argument of 1851, though General Gaines had inserted in his plea for railways and floating batteries in 1839 some bitter words about abolitionists, along with a hint of his contempt for General Jackson; these advocates of human freedom were, he fancied, mere spies and pioneers subsidized to support English interests—like the favorers of free ships denounced by the prize-essayist of 1910. Maury's illusions were more generous, and his rhetoric was no warmer than that of the conservative DuPont, who also believed that we could filibuster in Europe and quoted "Her march is o'er the mountain wave," to show what we could do at sea.

During the four years of the Civil War Maury's prophetic view in regard to blockade was confirmed with decisive results. Totten's opinions were less fortunate; of all his barriers forts Sumter alone proved invincible to naval attack. He had written in 1851 that when Forts Jackson and St. Philip, below New Orleans, were completed no squadron, though it included 20 steamers built for

war, could force its way up the river; an opinion which Farragut was able to disprove, though the shore batteries had the support of gunboats and obstructions. It was also recognized that neither New York nor Washington had been secured against attack from ironclads like the *Merrimac* by the existing fortifications. Experience showed that improvised earthworks were stronger than casemated forts; that submarine mines were the best type of obstruction for harbors: and that ironclads could engage forts at close range or run past them without serious injury.

These facts were obvious to the Fortification Board of 1886, the so-called Endicott Board, which included representatives from the navy. Admitting that the existing works were of little value, the board did not renounce the system under which they had been planned, though the number of harbors to be fortified was reduced to 27 and the number of guns in like proportion. The great Lakes were still to be guarded, but there was no hope of closing Long Island Sound or Chesapeake Bay to an enemy, and estimates for batteries at New Haven and Baltimore were prepared accordingly. Localized floating batteries and torpedo-boats were recommended, and these would have withdrawn 7500 men and a large body of officers from the fleet in time of war. The monitors and flotillas were to act against blockading forces, while the regular fleet was to find its field of action on the high seas "in protecting our commerce, in destroying the commerce of the enemy, and in making attacks upon undefended or important positions on his coast (thus forcing him to maintain a fleet at home), or in meeting and destroying his fleet." Though Admiral Sampson drafted this paper, its last clause is the only one indicating any strategic employment for the fleet.

The report of 1886 attracted the attention of Sir G. S. Clarke, now Lord Sydenham, who, in his *Fortification* (1890), deals roughly with British panic-mongers and their works: "Thus we have seen waves of coast defense which have strewn our shores with derelict fortifications technically bad, even in their own day, and now worthless, while the requirements of the field army have been uniformly ignored." He then refers to the "preposterous proposals" of the Endicott Board as setting up "extravagant standards attainable only by a people disposing of superabundant funds, and, if attained, adding nothing to national security," instancing the estimate for San Francisco as an extreme case.

Whatever may be the verdict upon the proposed works on shore, which were not complete enough to prevent panic in 1898, the military problem of the present seems to be to find garrisons for the existing forts and to organize field forces to protect them from siege. It does not appear that harbors which might serve naval strategy as *ports de sortie* have been extensively fortified, though much attention is now given to the fixed defenses of the Isthmus and the insular possessions of the United States. The influence of the board's report on naval progress, though discounted by Admiral Mahan's demonstration of the futility of commerce-destroying cruises and raids, is embodied in the *Minneapolis* and the *Monterey;* types which will hardly be repeated or developed in future. But we no longer hear of groups of vessels for the defense of a single harbor; and it is now generally admitted that, "the primary requirement in war is that we shall be able to take the offensive at sea."

THE CONSTRUCTION AND ARMAMENT OF THE FLEET.

Naval strategy and national defense are still controversial topics, but there is little ground for debate concerning naval matériel as provided in the last century. The inventor of one generation may become the sworn guardian of tradition in the next; therefore, the citation of views which were obsolete before their supporters left the active list implies no censure; and names of note may be found in manifestoes against progress, while many rational innovators who fell short of high rank have been duly forgotten. As far as they relate to concrete weapons or mechanical designs, the notions of progressives and conservatives who flourished before 1901 are now obsolete and archaic. Yet they may still offer material for a chapter of the history of a service and illustrations of the tendency of doctrine to survive its useful applications. It may answer better to quote the average opinion, without much regard to rank, rather than that of the more articulate innovator or reformer. Representative views have more importance than those which may be more plausible and ingenious. Now and then, however, the innovator has been able to impose his views and to ask the service to mark time until his new device was perfected, or at least made practicable.

No close comparison of contempory opinion in foreign services will be attempted, though the official papers of the British Navy

would yield a harvest no less curious than our own. The retired captain or well-placed admiral given to saying that a thing "might be so in theory, but it would not work in practice," has had more to say in the Royal United Service Institution than in our Naval Institute. Yet dreadnoughts have been built, in spite of his warning "not to put all the eggs in one basket"; and our service, in which the education of junior officers was once in advance of the instruments committed to their charge, has outgrown many maxims due to instinctive conservatism. But we have had to contend with that patriotic prejudice which hesitates to adopt the conclusions of foreigners, and is unable or unwilling to repeat their experiments.

Occasionally a foreign writer was credited with authority in matters beyond his competence, or his influence was extended to a period when new conditions required new interpreters. This was notably the case with Sir Howard Douglas (1776-1861), whose name was long prefixed to our standard work on Seamanship because he fancied that tacks and sheets would outlast coaling-whips. This eminent soldier had an inherited interest in the British Navy; he believed that his father had suggested the movement by which Rodney broke the French line in 1782; and he set forth that opinion in his *Naval Evolutions* 40 years later. His *Naval Gunnery* dated from 1820; and his *Naval Warfare under Steam* was written in the last decade of his long life. All these books demanded reforms, but the last of them also protested against progress in motive power, in construction, and in ordnance; and it was absurd to condemn improvements in any of these lines on an authority which had certainly become obsolete before 1865. Yet Admiral Luce was not the only compiler of text books for the Naval Academy who banned modern methods by citations from Sir Howard Douglas.

Steam versus Sails. Steamers were trading across the Atlantic before 1841, and the Navy Commissioners had been forced to recognize steam as an auxiliary to the extent of asking for 25 steamers along with 100 sailing-vessels required to make our naval forces respectable by 1851. The economic objection had to be reckoned with. Totten's arbitrary comparison between ships and forts made the most of his theory of multiple squadrons for defense. The excessive cost of repairs, under the practice which allowed for no change of type, but gave each ship an indefinite lifetime by patch-

work—a system maintained up to 1883—counted against the development of the fleet by the construction of steamers. Moreover, as Totten pointed out, machinery multiplied vulnerable parts and limited the battery in all steam-vessels. He could even invoke progressive ideas to limit naval increase; steam might soon be replaced by something more potent, so that a new steamer might be an incumbrance in ten years; therefore, he urged, "in relation to the preparation of steam-vessels for warlike purposes generally, that wisdom would seem to direct a very cautious and deliberate progress," though timber might be accumulated under the protection of his forts. Thus steamers could be built "when about to be needed." The opinions of such an expert might be disregarded had they not been echoed, upon different grounds, in the higher ranks of the navy.

Thus in 1851 Commander Cunningham had something to say for floating batteries, but made sailing frigates 240 feet long the vital element of the fleet. Had we ten of these armed with heavy guns, "it would take the combined steam navy of Great Britain to cope with them." He added, with some confusion in his grammar, this appeal to the traditions of the service: "As to the opinion that is rife among us that steam alone can constitute an efficient navy, and that the nation who can command the greatest number of steamers is to hold supremacy on the ocean, I regard as one of those visionary speculations based entirely upon the opinions of mere theorists." Yet Commodore Perry was already convinced of the absolute necessity of employing steamers "in all naval operations." Even Cunningham would use them for towing and for transporting supplies; but two years of war would bankrupt any European power that armed a large steam navy; and he trusted that "our government will not be drawn into so unwise and expensive a system of national defense." DuPont accepted steam-power as an auxiliary in large frigates of the *Princeton* type, and this half-way doctrine had a long lease of life.

The Secretary of the Navy stated in 1856 that the *Niagara*, like the frigates of the *Wabash* type, had steam as an auxiliary only, thus "preserving unimpaired all the essential elements and capacity of the sailing-vessel." This unattainable standard was renounced by 1859, when the *Wyoming* class of sloops had "steam as the principal motive power, with sail as an auxiliary"; but most of this type fell to a 6-knot speed by the middle of their inter-

minable career as cruisers. It is notorious that our commerce on the high seas lacked protection during the Civil War, and that the *Wabash* sisterhood had to be dismantled for service on the blockade. With the help of steamers of less stately types, including the monitors, the southern ports were closed, and the economic pressure dreaded by the conservatives of the navy was thus shifted to the shoulders of that belligerent who was forced to accept fortifications as the principal factor in coast defense. It had been proposed to purchase and arm sailing-vessels to pursue commerce-destroyers or assist in the blockade, but the plan was dropped without experiment.

In March, 1869, the Navy Department passed from the hands of Secretary Welles, and his successor was advised and directed during a brief term by the vice-admiral of the navy. After 40 notable general orders had been issued the wave of reform—or reaction—was checked. Staff officers had lost uniform and rank, which they soon recovered, Indian names, some of which had won honor in battle, had been replaced by classical or scriptural names for ships, which did not outlive the advent of a new Secretary in August. But the attempt to restore the old seamanship and customs of the service had a longer effect. The order to paint spars black and white was soon withdrawn, and the prohibition of shellac on lower decks also lapsed, for sanitary reasons, no doubt. But general order No. 128, prescribing 18 drills or "evolutions" with spars and sails for the routine of vessels in port was enforced for a whole generation. It was rarely found practicable to anchor or leave port under sail, but all hands could send down light yards, or even top-gallant masts, in a few minutes; and the "spirit of emulation" was directed that way. Full sail-power was to be restored to all vessels, including those then rigged as barks or schooners, whether they were at home or abroad; and then they were to do "all their cruising under sail alone, which will not only have the effect to economize coal and save expense, but will also instruct young officers in the most important duties of their profession." Captains might have their pay checked for using steam unnecessarily, but the exercises of a squadron were not so rigorously enforced. Doubtless there are some distinguished officers still alive who regard Admiral Porter's decrees as beneficial to the service, though others hold that the era of stagnation lasted as long as they prevailed.

Their educational theory was generally accepted. Thus in 1872 Captain Jeffers reported that the *Constellation,* then under his command, represented the only type fit for midshipmen to cruise in: one trained to handle such a ship would never "find himself at fault in handling a steamer; the evolutions are simpler, more accurately and promptly performed"—a remark opposed to the modern preference of teachers for passing from the simple to the complex. All naval steamers, the captain added, were "uncertain" while under sail, and this made officers so timid that steam was used in case of doubt. After all, since bad weather made our screw steamers helpless without the aid of sails, seamanship remained "the first attribute of an officer." Yet it was hard to live up to this doctrine when manœuvers were restricted by fine weather; "no information of value is conveyed by simulating under top-gallant-sails those required under close-reefed top-sails." The prescribed routine, however, adhered to that sort of simulation and ignored the exact handling of steamers required for the day of battle.

The Advisory Board of 1881 recommended the construction of cruisers of an advanced and novel type, but added that "all classes of vessels should have full sail-power," the sails to have 25 times the area of the midship section, and the rejection of twin-screws naturally followed. When the "white squadron" vessels were designed Chief Constructor Wilson pointed out that the *Chicago* fell far below this proportion, and that the *Atlanta* was in worse case, and he proposed to substitute the design of the *Vandalia,* built in steel, in order to save coal. Captain Sampson applied the formula of least resistance to these calculations, thus showing that the supposed economy was impracticable, and his testimony silenced the demand for full sail-power. The educational theory outlived the economical plea, and it had to be met by a new exposition of the nature of seamanship as the art of using the nautical equipment of the day with skill and confidence. Admiral Knight has shown that there was as much to be learned about ropes disdained by the old seamanship as about its favorite tacks and sheets; springs, fasts, and tow-lines, for instance, have replaced nine-tenths of the old running-gear; and, unless seamanship claims to be merely an arbitrary and immutable code, it has to deal with their management. Cruisers used to enter port with all the officers so intent upon shortening sail that such matters as

pilotage had to be left to local practitioners; and dubious and timid navigation characterized the sailing period.

In 1901 the PROCEEDINGS contained a notable demand for the continuance of sail-power, at least in ships attached to the training-stations. Captain Chadwick, to go back to the titles of that year, had urged nothing more; but some of his supporters went further. There was to be a period of training before transfer to the fleet "in ships fitted with sails only"; but, though several officers connected with the training service endorsed this plan, it was not made effective. Captain C. H. Davis made the proposal a text for an assertion that sails had "kept the service and the spirit of the service alive when it was an alternative between sails and extinction." It was conservatism, he added, that had "carried us through the disastrous years of decadence following the Civil War and fitted us for the changes" resulting from the reconstruction of the fleet. On the other hand, Captain Sigsbee asserted that he had become convinced while serving at the Naval Academy that "training with sail is not only of doubtful benefit to the service, but that it is very harmful." When he had attempted to teach modern—and therefore practical—seamanship he had been discouraged from preparing a text book to replace a certain compilation of "the fragmentary experiences of seamen from the beginning of time," on the ground that the prime necessity was to train midshipmen to work a ship under sail. The discussion was closed by a contribution from the retired list. Commander Rittenhouse declined to hold "skill in the use of sails and spars as the full and exact equivalent of seamanship." "So long as men go to sea, whether in sailing-ships, in mastless steamers, or in submarines, there will be seamen and there will be seamanship."

Iron and Steel in Naval Construction.—Fortified by the verdict of Sir Howard Douglas that there was "no worse material for ships' hulls than iron, except steel," our text books up to 1871, at least, held that iron vessels were "utterly unfit for purposes of war." Even in 1877 the Secretary of the Navy condemned the *Ranger* and her two consorts because they were "built of iron and uncased, a construction for many years discarded for cogent reasons." These had been stated in 1873 by an ingenious contributor to the Army and Navy Journal, who may have been an officer of rank, and his protest had a considerable body of service

opinion behind it. The bottoms of iron ships would be eaten out, he said, by quicksilver from the gauges—he might have added from the absurd combined fog-horn and bilge-pump recently installed; the shattering of plates by a single shot might sink a ship, or grounding on a rock might be equally fatal; the local attraction of the compass would be a constant source of danger; the hull would be "excessively unhealthy, hot in summer, cold in winter, and never dry"; it would have to be cleaned in dock very often, and repairs would begin on launching, "to replace the ribs and rivets caried away in that process." Douglas had pointed out that, though it might be necessary to supply armor, the hull must still be of wood; otherwise, and especially if fitted with compartments, it would be ruptured on grounding by strains "tending to fracture it at the section which divides the filled from the unfilled portion." One of the largest monitors was built of wood at a navy-yard during the Civil War on this reasoning, though Ericsson's design called for iron construction. Douglas warned the Admiralty to accept no auxiliary vessel from the merchant marine if its compartments were enclosed in an iron hull. He also insisted upon the dangerous "compound effects of fragments of an iron ship" mixed with those of a bursting shell; and this warning long held a place in American service manuals.

Nevertheless, the Advisory Board of 1881 recommended the use of steel in all the large cruisers of the new navy; though the stock of timber at the navy-yards was so large and the workmen so well prepared to handle it that gunboats should be built of wood. From this recommendation three constructors and the senior engineer of the board dissented; Americans could manufacture iron plates more readily than steel, the importation of which would send money abroad and give profits to middlemen. Besides, steel had no advantage where rigidity was required, and the total saving of weight elsewhere would be only 3 per cent. "As the mild steel is more corrodible than the iron an additional thickness must be given to it," making the weight the same for "British mild steel or first-class American iron." There may have been a political appeal in this designation of materials, which took little account of experiment or the opinions of experts; but the objections to steel were somehow overruled.

Floating Batteries and Monitors.—In the American discussion of naval forces for coast defense these types held a place out of

proportion to their final value. Though experiment was left to private enterprise, and the design of the Stevens battery was never accepted by the navy, a whole series of arguments in favor of floating batteries is extant. General Gaines urged, in 1836, the assignment of two or more such vessels to each of the principal harbors. Hulls from 200 to 300 feet in length and nearly half that beam could mount at least 100 guns, and tugs were to be provided to tow them into action or to force them along when rigged as ploughs to dredge the channels.

Inordinate expense was alleged by military and naval critics, and one of the latter objected to the creation of "a little military navy." General Totten opposed every plea for substitutes for fortifications, but admitted the necessity for floating batteries in certain bays and estuaries. Commander Cunningham, who believed in fighting under sail up to 1851, proposed steam floating-batteries built of logs and plated with strips of iron six inches wide —Gaines had proposed "sheet iron of immense thickness" as armor. Cunningham would have the engines kept in store, but batteries of 10-inch guns and mortars were to be mounted. Du Pont had no confidence in such vessels, and he noted that a target of seven boiler plates, equal to the side of the Stevens battery, had been penetrated by a naval gun. Totten condemned all attempts to build shot-proof batteries; sides thick enough to keep out grape but so thin that shells might pass through both sides without bursting were all that were needed for any vessel. Commodore Perry proposed to have floating-batteries fight at such a range that there would be no risk from grape or splinters.

In spite of demonstrations in the Black Sea in 1855, the Civil War began before any armored vessel had been designed for our navy. Nor were officers prepared to make a critical examination of designs submitted by civilian engineers; the board which accepted the *Monitor* and the *Ironsides* also authorized the worthless *Galena*, the Chief Constructor declining to revise the plans because it was no part of his trade, and the rest of the board acting under pressure due to the panic which the *Merrimac* had begun to create. Crude as Ericsson's plans were—the wheel rotated with the turret in the original sketch and the substituted pilot-house was a dangerous obstruction—the *Monitor* did her work and sounded the knell of unprotected squadrons, and this success allayed panic in New York and Washington. Unfortu-

nately, the general principle upon which these "shielded floating-batteries" were constructed was made an article of faith by the Navy Department, and attempts to promote tactical efficiency by meeting the demands of officers who became experts by fighting the monitors at Charleston and elsewhere met with no official or popular encouragement.

The board which approved the construction of the *Monitor* doubted whether any such vessel could cope with modern forts, though they might run past to undertake "ulterior objects"—a view which failed to allow for mines and other obstructions. After a preliminary test under the guns at Fort McAllister, which convinced Admiral DuPont that the monitors were lacking in aggressive power, the defenses of Charleston were assailed on April 7, 1863. The six vessels which lay within 1000 yards of Fort Sumter were struck oftener than they were able to fire, and their captains discovered that, though the turrets were not penetrated, they were bulged inward or knocked out of the perpendicular by the impact of shot, and that, on the whole, they lacked "offensive power and endurance." The raft by which each vessel was to sweep away the mines also proved unmanageable, and DuPont declined to renew the attack. An officer who was present in the capacity of "general inspector of iron-clad steamers and harbor-obstruction submarine shells," protested; the monitors had proved that their laminated plating was stronger than the solid armor of the *Ironsides*, though the casual observer might not agree with the "unprejudiced engineer" about this; and the attack had not been made in earnest because of prejudice on the part of the admiral and the captains. Chief Engineer Stimers having communicated these notions to the inevitable journalist, DuPont preferred charges, which a court of inquiry saw fit to ignore, after an aggressive plea from the accused, who had, he wrote, said "no more than he was authorized to say." DuPont had tried to justify his inaction "by attacking that system of war vessels which has already, in my opinion, given us a more effective fleet than is possessed by any other nation . . . . An assault upon the system can but recoil upon the assailant." So it proved, and DuPont was dismissed from his command; but his successor, Admiral Dahlgren, did nothing to demonstrate that the monitors were invincible.

Stimers went on to supervise the construction of 20 light-draft monitors of 700 tons, oval tanks with flat bottom and vertical sides enclosed by a raft of timber faced with armor. Such was Ericsson's original idea; but the design was modified without his consent or that of the chiefs of the bureaus of construction and engineering. Some additions in weight were due to the introduction of patented devices by interested draughtsmen, and Stimers was blamed for adding tanks or compartments to the hull. The completed vessels sunk 16 inches below their estimated draft of 6 feet as soon as the turret was put on board; and this made the deck awash. Besides being unseaworthy, these monitors had a speed of only 4 knots, their propellers being enclosed in a box. It was proposed to turn a few of them into torpedo-boats, without their turrets; but the lack of speed and the length of 225 feet made them unfit for that purpose. Stimers tried to defend himself at the expense of his superiors, who met his challenge by writing to the newspapers, of course; but his day was over, and he was ordered to sea. Official support and the suppression of criticism had ruined his career—to say nothing of the wasted millions. He claimed that he had done much to improve the design of other monitors, which, had he not disobeyed orders from Washington, would have been encumbered with spars and sails; but it is evident that the constant criticism of sea-going officers was indispensable if the crudities of the original plan were to be corrected.

The attempt made to show that the larger monitors were fit for long cruises in the Atlantic and Pacific oceans was meant to impose on public opinion rather than upon that of the service; and the repaired monitors which appeared at Key West during the demonstration of 1874 were not regarded as tactical units. Unsytematic patchwork had not made them seaworthy; but five double-turreted monitors were designed to take their place. These were all launched by 1883, though a pair of them were not fit to be commissioned before 1898. The problem of employing monitors in warfare was never settled by practical tests. New York and Philadelphia had demanded such defenses in 1862, and the Navy Department was forced to distribute worn-out specimens to allay local panic in 1898, regardless of their tactical value and strategical principles. John Bright, a friend to the American cause as well as that of peace, hoped in 1863 that the heavier monitors might "be used only for defense, and be unable to cross

the ocean"; and the experience of the Spanish war justified his expectations. Neither the monitors which masqueraded as battleships on the Cuban coast nor the pair whose baffling voyage in the Pacific hampered strategy in the Philippines justified the perpetuation of the type; yet four monitors were authorized by Congress in 1898. The opinion of the Endicott Board of 1886 might have been cited in their favor, but the navy had long outgrown the doctrine of 1865, as set forth in the history which Dr. Boynton was made a professor and chaplain to write. It asserted the superiority of our fleet to that of any foreign power and based that claim largely upon the fighting qualities of the early monitors. In 1877, on the other hand, the Secretary of the Navy found, from his experience with that type, that "heavy armor-plated, gun-bearing vessels are not capable of sea-service. They are suited for little else than harbor defense, and may be likened to movable fortifications." Whatever the monitors might deserve, this was too harsh a criticism of existing battleships; but of these the department had only imperfect descriptions accompanied by invidious comments from prejudiced officers.

Rams and Torpedo-Boats.—The tactical function of these weapons, at least in the types known before 1901, was so nearly identical that they may be classed in the same series, provided we allow that the ram could not survive the modern development of the automobile torpedo—a fact which those responsible for the construction and armament of several of our battleships were rather slow in recognizing. Tactical theory also granted too much to the rams, and their overestimate of the value of end-on fire hindered the adoption of that flexible single-column formation which has characterized recent naval engagements. It was natural that advocates of naval progress in 1851 should urge the construction of long, narrow, and deep vessels to be used as projectiles under steam. Commodore Perry thought that they might be built of either wood or iron; Commander Cunningham would use heavy timber with longitudinal strips of iron let into the planking; Admiral L. M. Goldsborough would admit armor, but he felt that a battery would be "of more harm than good in the long run." Admiral Ammen's campaign for vessels of this type seemed to have the support of the Advisory Board of 1881, which recommended five rams, though unable to insist upon the construction of any armored ships. The *Katahdin* was the sole result of this

proposal, and her usefulness began when she was made a target for the broadsides of the fleet.

The Advisory Board also recommended the construction of torpedo-boats of light tonnage, but, like those planned by the Endicott Board in 1886, the flotillas were only fit to be localized for harbor defense. The theory of ramming, which had gained nothing during the Civil War, was revived after the battle of Lissa in 1867, but without practical result. The modern battleship should be able to sink rams by her torpedoes or her guns, and destroyers and submarines could prevent them from intruding upon the line of battle.

Ordnance and Gunnery.—Prior to 1841 the aggregate cost of guns is the main element of the problem of arming forts and ships. Neither the Navy Commissioners nor the Board of Engineers contemplated any change of type or increase in caliber. Of the 10,000 guns to be mounted on shore, the majority were to be 32-pounders, though some 42-pounders were in use; and the 4000 guns of the navy were of even lighter weight. When comparisons were in order caliber was not taken into account; thus a ship-of-the-line costing $500,000 could mount only 80 guns, which must be rated at over $6000 each; but Fort Adams could be armed with 458 cannon at $3000 each for the cost of the masonry. In either case, the expense of casting the guns was slight. For a steamer carrying ten guns the cost of mounting might be reckoned at $60,000 apiece. The demand for columbiads and other heavy shell-guns soon spoiled these estimates, and by 1851 even General Totten had to accept the new armament for his forts, though he insisted that ships would have to use solid shot to batter masonry. Yet he made no estimate for rearming the fortifications, and thus gave Maury and Dahlgren occasion to criticize. He might, however, have quoted Sir Howard Douglas, who was still convinced that the British navy could not afford to employ shells with time fuses, which he called " an atrocious kind of warfare "—an expression reflecting public opinion in England after the destruction of the Turkish squadron at Sinope in 1853 by Russian ships armed with Paixhan guns. No scruples were apparent during the Crimean War; and the American Navy followed its tradition in increasing the armament of steamers built before 1861 to 9-inch guns in broadside and 11-inch mounted on pivoting carriages.

All these were cast-iron smooth-bores; the failure of the *Princeton's* wrought-iron gun had discouraged experiment, and there was little talk of rifled cannon prior to 1861. The Parrott rifles rendered good service during the Civil War, but their trick of bursting left them in discredit. Thus in 1864 Admiral Dahlgren could tell Congress that all that was needed to provide the fleet with the best ordnance was the purchase of certain deposits of ore from which the best casting could be made. The interested advocates of rearming the navy with cast-iron guns about 1884 could cite plenty of such opinions. Dahlgren disliked Rodman's plan of hollow-casting, and he described his own design—which related only to exterior lines and the distribution of metal—as "an invention and in nowise the result of experiment." There had been no experimental determination of the charge of powder, and the monitors had to fight with reduced charges, which prevented their guns from doing all that they should have accomplished against masonry or armor. For endurance, the test was to fire 1000 rounds from sample guns, and Dahlgren held that it was useless to seek for accuracy and penetration beyond 2000 yards, the maximum range for naval actions. Rifled cannon were therefore condemned, with much stress upon reported failures of British weapons. His successor in the Bureau of Ordnance, Captain H. A. Wise, favored no change, and he thought the bureau should be "the safeguard of the service against the monstrous and visionary schemes of would-be inventors and speculators." There was much talk at the Naval Academy and elsewhere in the later 60's of the advantages of the Dahlgren guns, due in part, it was assumed, to the smashing or racking effect of their shot against armor. As rifled guns lost the chance of hitting by ricochet, Admiral Porter argued in 1869, a battery of 11-inch smooth-bores could beat twice as many rifled guns if the vessels fought in a sea-way.

Dahlgren's final opinion, as stated in 1868, was that, though an experimental station might be useful, we need take little account of the inclination of the French and English for rifled cannon, the experience of battle having largely corrected that tendency in our navy. Yet DuPont was counted among the dissenters from this current opinion. Dahlgren felt that the service would give him credit for his intolerant attitude toward breech-loaders; at any rate, "the plan of loading at the breech is exploded and dismissed." It should be remembered that the failure of the first

heavy rifles made by the Armstrongs for the Crimean campaign had produced a reaction in England, and that the British navy was still armed with muzzle-loading rifles in the '80's. American midshipmen were called upon to recite from Cooke's *Gunnery* (2d edition, 1880), that loading at the breech did not make fire more rapid, since pointing took longer than loading; and that, though breech-loaders might be made longer, it was of no use to make them lighter, since weight was necessary to enable the recoil to be regulated. Self-satisfaction was not universal, however, and Admiral Case, chief of the Bureau of Ordnance—which had been forced to lend money to other bureaus—regretted in 1870 our "virtual abandonment of all effort to solve the great ordnance questions of the day." His successor, Admiral Jeffers, urged in 1874 "the entire rearmament of the navy with breech-loading rifled cannon," adding the curious argument that it could be done cheaply while we had so few vessels to arm. In practice he did not get beyond the Palliser system by which 11-inch smooth-bores became 8-inch rifles with unhandy carriages and doubtful tubular linings. The Advisory Board of 1881 had the data of Krupp's experiments to work on, and it was declared "imperatively necessary that a reliable type of high-powered, rifled, breech-loading guns should be introduced into the service," specifying steel built-up guns 26 calibers long. This put the ordnance question on a sound basis, and the experimental station has furnished the data for further progress. It should not be forgotten, however, that systematic target-practice was not carried out before the Spanish war and that black powder was still in use in 1898. Nor were the observed results of firing at hostile ships of much value for solving the problem of future armaments and their use. They were too often interpreted in favor of the particular type of guns carried by the observer's ship, and there was the inevitable tendency to claim accuracy of fire as a patriotic duty. Whether the evidence favored the advocates of "all-big-gun" battleships is questionable, but that formula did not survive reconsideration, and, though we still talk of super-dreadnoughts, the anti-torpedo guns amount to a formidable battery.

CONCLUSION.

That service opinions should have been discordant at various periods is natural enough; but the survival of obsolete rules of practice as the basis of conservative tradition is a more serious phenomenon. Unanimity would have made matters worse, but there was, in fact, little opportunity for protest or even for discussion. Rank was apt to mean conservatism, and the instinct of subordination, combined with that for belonging to the majority, tended to make criticism frivolous, because it had to be unofficial and without effect. Captious talk can be of no benefit to the service, but a serious statement of definite opinion is urgently required for the solution of pressing questions whenever new forces can be applied to the fleet. The views of mechanical experts are not all that is required; the sea-going officer has to accept and understand the instruments which he alone can render efficient, and the art of forming and expressing opinions relating to technical problems can only be attained by making it a part of his professional education. There is no higher branch of naval training than that which gives promptness and clearness in dealing with critical situations by a definite analysis. Even in these days of specialization every officer is bound to hold a wide range of technical views and to be able to apply them with prompt and fearless discretion. The art of acquiring and formulating such opinions is now taught at the War College and in some of the post-graduate courses of the Naval Academy, but its general cultivation among the officers cruising in the fleet may still require attention.

Thirty years ago an essay by the present writer was honored by publication in the PROCEEDINGS OF THE NAVAL INSTITUTE, and in that appeal from the era of stagnation there was a suggestion in favor of the promotion of intellectual activity in the navy by means of required essays on elective topics. It was proposed to have the papers pass through official channels, each superior noting a serious comment on matters within his competence, and a special director classifying those which required to be committed to experts. Publication in these PROCEEDINGS or elsewhere might be the lot of the more popular and readable essays. Technical criticisms might require reserved treatment, and personalities would, of course, be returned to their authors. It is possible that the information thus collected might be of considerable value; and

it is certain that the habit of expressing one's opinions in a form that would be intelligible to higher authority and not beneath the criticism of experts in the service would be a valuable development of the professional aptitudes of the younger officers of the navy.

NOTE.—The *"Report on Permanent Defenses,"* which has furnished a large part of the citations given above, has not been discovered in any of the official indexes to Congressional public documents. Yet it is a book of 528 pages and includes the paper by Maury and others of historical interest. It is therefore identified as House of Representatives Report, No. 86, 37th Congress, 2d session (1862). Powell's "Apalachicola Report" was not then reprinted, but it had appeared as House Document No. 220, 37th Congress, 2d session (1842).

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A HALF CENTURY OF NAVAL ADMINISTRATION IN AMERICA, 1861-1911.

By CHARLES OSCAR PAULLIN.

V.

NAVAL SHIPS AND CONGRESSIONAL INVESTIGATIONS, 1869-1881.

The duties that fell to the navy during the peaceful administrations of Grant and Hayes were not specially important. Its vessels made the usual cruises in foreign waters for the protection of American property, commerce and citizens. A few of them were engaged now and then in making hydrographic surveys or in performing other scientific tasks. The fleet was regularly divided into the North Atlantic, South Atlantic, European, Pacific and Asiatic squadrons, and "vessels on special service," but at times the North Atlantic and Pacific squadrons were each divided into two divisions.

Twice during Grant's first administration a war with Spain seemed imminent. The war-scare of 1875, which has now been generally forgotten, soon subsided, but not until the department had concentrated a fleet at Port Royal, South Carolina, and had ordered home some of its ships from Europe and South America. The war-scare of 1873-1874, known as the *Virginius* episode, is probably familiar to most readers. A notion of the extent of the warlike preparations that were then made by the Navy Department may be obtained from a letter of Secretary Robeson to James A. Garfield, chairman of the House Committee on Appropriations. On December 8, 1873, Robeson wrote: "I have taken measures to put every available iron and wooden ship of our Navy in condition for immediate duty. I have ordered all the ships of the various squadrons within reach to rendezvous at Key West. I am enlisting men to supply and fill up the crews of all our vessels.

I have accumulated materials, provisions and supplies for their maintenance and support, and ordnance, ammunition and all the weapons of naval warfare for their use." [104]

Early in 1874 the differences between the two governments were settled by peaceful means, and the navy and the department settled down to that state of passivity and stagnation which generally characterized them at this time. The panic caused by the *Virginius* episode cost the department some $5,000,000, an expenditure for which no adequate return was received. The assemblage of a fleet, however, served to reveal the extreme weakness of the matériel of the navy. Rear Admiral Robley D. Evans says that the force which was collected at Key West in the winter of 1873-1874 " was the best, and indeed about all, we had. We had no stores, or storehouses to speak of at this so-called base of supplies, and if it had not been so serious it would have been laughable to see our condition. We remained several weeks, making faces at the Spaniards ninety miles away at Havana, while two modern vessels of war would have done us up in thirty minutes. As there was to be no war, the authorities in Washington allowed the foreign attachés to come and inspect us, and report our warlike condition to their different governments. We were dreadfully mortified over it all, but we were not to blame; we did the best we could with what Congress gave us." Several weeks were spent by the squadron in fleet maneuvers before its vessels separated.[105]

Owing to the *Virginius* episode the annual expenditures of the Navy Department during the period 1869-1881 reached their highest mark in the fiscal year 1874, when they amounted to $30,859,000. They were lowest in 1880, when they had fallen to $13,537,000. They were much higher under Grant than under Hayes. The annual average expenditures for the eight years 1870-1877 were $21,709,000; and for the four years 1878-1881, $15,428,000. The total expenditures for the former period were $173,675,000; for the latter, $61,714,000; and for the twelve years, $235,389,000. By counting certain proceeds derived from the sale of vessels and certain payments of money made under Thompson, but really chargeable to Robeson, the minority of a committee of the House of Representatives friendly to Robeson calculated that the expenditures of the Navy Department from July 1, 1869, to June 30, 1877, were

[104] Congress Letters, U. S. Navy Dept. Arch., XV, 222.

[105] House Miscl. Doc., 45 C. 3 S., No. 21, 132; Evans, A Sailor's Log, 171.

$186,311,000. According to these figures, the annual expenditures during these eight years were $23,289,000. The chief items of expenditure were "for pay and support of the navy and marine corps," $73,700,000; "for construction and repair and steam engineering," $53,429,000; and "for yards and docks," $18,714,000.[180]

The navy cost the country considerably more money during the eight years of Grant's administration than during the eight years 1884-1891 when the new navy was under construction. During the seventies Congress was indifferent to naval affairs, rather than parsimonious in its naval expenditures. It gave liberally for the maintenance of the navy, but almost nothing for the construction of new ships. It viewed with unconcern their increasing decay and obsoleteness. Questions of reconstruction, finance, and party success engrossed its attention. The Democratic party was especially committed to the policy of economy in the management of naval affairs. A Democratic House of Representatives, which first came into power in December, 1875, was largely responsible for the reduction in naval expenditures trat was made in the immediately succeeding years. The Democrats succeeded in discrediting Robeson's administration, and in creating a sentiment for reform and retrenchment in the management of the department. During 1877-1881 the navy touched its low-water mark. Indeed, probably less was done for the improvement of the fleet under Hayes than during any administration since that of Jefferson.

Many members of Congress believed that, owing to the large national debt, the country was not able to embark upon a program of naval construction. The opinion was common that the United States should not adopt the policy of building seagoing war vessels after the manner of the European nations, but should confine its construction to coastwise vessels of defense, to monitors, torpedoes and marine rams. This view was well expressed by Senator George S. Boutwell, of Massachusetts, the most seafaring state in the union. In February, 1877, he said in the Senate that he believed that the "time passed several years ago when it was for the interest of this country to make the least preparation for an open sea fight. Anybody who looks at the character and extent

[180] Sen. Ex. Doc., 45 C. 1 S., No. 3, 157; Ann. Rept. of Sec. of Treas., 1877 to 1881; House Rept., 45 C. 3 S., No. 112, 95-97, 109-111.

of this country, the number of its people, and the magnitude of our influence as a nation, must see that an open sea fight would settle nothing in any controversy that we might have with any power upon the face of the globe; and to be expending money year after year, whether one million a year or ten millions a year, or twenty millions a year, with the idea that something is to be gained in a naval contest, has no foundation in any generous conception of public policy." He thought that it was not for the "interest of this country to expend a dollar for naval appropriations directly, except such as are necessary for coast defenses. To such perfection has the construction of torpedoes and steam-rams been carried that there is not a navy on the face of the earth which could enter a harbor that is protected by these modern inventions." If vessels were to be built, he would construct those of about one thousand tons each, capable of carrying from eight to ten guns and of outsailing the larger ships of war. However, "such is the pre-eminence of this country to-day, so valuable is it a market for the products of every nation on the globe, that we can command our rights by withdrawing our diplomatic representatives from any country on the face of the earth." [107]

Like Boutwell, many of the naval experts in Congress and some of the secretaries of the navy pinned their faith to torpedoes, marine rams, submarine batteries and smooth-water monitors; the "monitor heresy" was still vigorously thriving. Even these minor craft were not regarded as essential by the more rhetorical and sentimental members of the House, for they were able to discover an adequate naval defense in the great moral force of the American people, and in the intelligence, industry and ingenuity of the most powerful nation on the face of the globe. Senator John Sherman, of Ohio, once suggested that the Navy Department might well be made a bureau of the War Department.[108] By no means, however, were all the members of Congress opposed to an offensive seagoing fleet, and especially during Hayes's administration did sentiment in behalf of the reconstruction of the navy increase. Indeed, the naval committees of Congress outran the Secretary of the Navy in recommendations for the construction of new vessels. Neither Secretary Thompson nor President Hayes took an aggressive stand on this question.

[107] Congressional Record, V, 1867.
[108] Congressional Globe, 1869-1870, p. 5329.

Hayes seemed to have almost forgotten that his country had a navy. Grant, on the other hand, was more interested in naval matters, and was somewhat inclined to improve the fleet.[109]

Robeson was more favorably disposed towards rebuilding and modernizing the navy than Thompson, although his utterances were not wholly consistent. In his first annual report he earnestly urged the building of seagoing ironclads. In the midst of the *Virginius* episode he said that "recent events have demonstrated to all that the great immediate military necessity of this nation is seaworthy war vessels, adequate to contend with those of other nations, and well-armed and completely equipped for cruising or fighting." On the other hand, in his last report he conceived that we might "well dispense, for the present at least, with the heavy-armored and unwieldy ironclads of European nations, and also with the monster cannon necessary to penetrate them."[110] Robeson, however, never balked at large naval expenditures, and he often stretched the law in order to obtain money for the construction of new ships. Thompson, on the other hand, made no clear-cut recommendations in behalf of a new navy. His reports contain long-winded discourses, in which he attempts to show that the navy and the mercantile marine are mutually advantageous to each other. From these, by proper industry, one may obtain the notion that he wished to have some new ships added to the fleet, sometime, when the public finances would permit it.

Not a few of the older naval officers pointed out to the proper authorities the weakness of our naval defense. They instituted comparisons showing that the American navy was yearly falling farther and farther behind the European navies in type and number of vessels, ordnance, and general condition of the whole naval matériel. They made it clear that the large list of vessels in the Navy Register was in reality a paper fleet, and that it would be of little service in time of war. No one person did so much to call attention to the actual state of the navy as Admiral Porter. Never inclined to mince his words, he expressed his views with great bluntness and vigor. In 1874 he declared in his annual report to Secretary Robeson that "there is not a navy in the world that is not in advance of us as regards ships and guns, and I,

[109] Richardson, Messages and Papers, VII, 40, 108, 196-197.

[110] Ann. Rept. of Sec. of N., 1869, p. 13; 1876, pp. 6-7; Sen. Miscl. Doc., 43 C. 1 S., No. 40.

in common with older officers of the service, feel an anxiety on the subject which can only be appreciated by those who have to command fleets and take them into battle." Moreover, "if called upon at this time to command the naval forces of the United States, in case of hostilities, a position which it is my ambition and my right to fill, I should be put to my wit's end to succeed with such an incongruous set of vessels as we now possess. Prudence would probably recommend that they be shut up in port and no fleet operations attempted with them—sending the wooden vessels abroad singly to do all the damage possible until captured by the enemy; our 50-gun frigates perhaps succumbing to a 2-gun clipper armed with 10-inch rifles, and our smaller cruisers driven off by merchant vessels carrying rifle guns of lesser caliber." Porter said that "it would be much better to have no navy at all than one like the present, half-armed and with only half-speed, unless we inform the world that our establishment is only intended for times of peace, and to protect the missionaries against the South Sea savages and eastern fanatics." Of all the vessels on the navy list he considers serviceable only 39 wooden ships of war and 6 monitors. "One such ship as the British ironclad *Invincible*," he declared, "ought to go through a fleet like ours and put the vessels *hors de combat* in a short time, for she could either run them down or destroy them at long range with her heavy rifled guns. We have no ordnance that would make any impression on such a ship at a distance of over six hundred yards, and no vessel of equal speed in our navy would be placed under her fire by a prudent commander." [111]

The period of 1869-1881 was one of differences of opinion among both naval amateurs and experts. This was in part doubtless inevitable, for a revolution, or several revolutions, were going on in naval science. The contests between wood and iron, and between iron and steel, as materials for the construction of ships; between steam and wind as motive powers; between armored and unarmored ships; between ordnance and armor; and between ships and torpedoes, were all still undecided. Robeson was much criticized for the kind of vessels that he built. But he doubtless followed the best light that he could obtain. The policy which the government should have pursued under Robeson and Thompson is precisely

[111] Ann. Rept. of Sec. of N., 1874, pp. 198-202.

the one which it later followed under Chandler and Whitney. It should have disposed of its worthless ships and of the huge quantities of old naval materials dating from the Civil War that encumbered the naval yards and stations. The running expenses of the navy under Robeson should have been reduced one-third, and this saving should have been expended for ships and guns of the most approved models. Had the government waited until the art of naval construction reached a static condition it would, even up to the present time, have constructed no new ships.

The total number of vessels in the navy in March, 1869, was 203; and in January, 1881, 139. This reduction, which was made almost entirely during 1869-1877, was caused by the loss of vessels at sea, by the sale of those that were obsolete or worthless for naval purposes, and by the breaking up of old ships for the uses of new. The number of vessels kept in commission was about fifty. Some notion of the character of these vessels may be obtained by considering the qualities of the flagships of the squadrons in 1876. They were all wooden, screw-propelled steamers with auxiliary sail-power. The *Franklin*, built in 1853, was a first-rate ship, with a tonnage of 3173 tons. The *Brooklyn*, *Hartford*, *Richmond* and *Pensacola* were second-raters and sister ships, dating from 1857 and having a tonnage of about 2000 tons. The *Tennessee*, which was of a later date, mounted twenty-three guns and had a tonnage of 2135 tons.

Congress authorized not a single vessel during the administration of Thompson, and only ten small craft during that of Robeson. In March, 1871, six hundred thousand dollars were appropriated towards the construction of two small iron-plated torpedo boats. These craft were completed in 1874, and were the first of their class in the American navy. The two boats, which were named the *Intrepid* and *Alarm*, were built experimentally and were only moderately successful. The *Alarm* was constructed from plans designed by Admiral Porter. Her dimensions were: Length, including a ram thirty feet long, 173 feet; breadth, 28 feet; and depth of hold below the spar deck, 13 feet. After modifications had been made in her machinery, the *Alarm* was considered well adapted in many respects for the service for which she was designed. In the seventies the science of torpedoes and torpedo-boats was in its infancy. Rear-Admiral Evans is of the opinion that most of the torpedoes manufactured at this time were

"good only for newspaper stories, or to scare timid people with."[112]

In 1873, in accordance with an act of Congress, the construction of eight small steam vessels-of-war was commenced. These, together with the two torpedo-boats, were the only vessels authorized by Congress during the years 1864-1881. Their total cost was less than one-half that of a modern battleship. Three of the eight ships ordered in 1873 had a tonnage of 541 tons each; four of 615 tons each; and one, the *Trenton*, of 2343 tons. The *Trenton* was a wooden frigate, and when completed was considered the finest ship in the navy. The other seven vessels were either iron or wooden gunboats. Of the eight ships, three were built by the department, and five by private builders. Two or three small vessels were purchased during Robeson's administration.[113]

Most of the vessels added to the navy during the Civil War were built under the stress of a great emergency and were not adapted for permanent acquisitions to the fleet. Unseasoned timbers, imperfect fittings and faulty machinery were often used in their construction. As a consequence they rapidly deteriorated. The keeping up of a navy of this sort inevitably absorbed large sums of money. Old patches were continually repatched. The repairs of the *Madawaska* (or *Tennessee*), within fifteen years after she was completed, almost equaled in cost the original value of the ship, $1,856,000. In 1883 the ninety-two best vessels of the navy had cost for repairs more than their original cost of construction. For many years old worthless hulks in ordinary stood rotting at the wharves or remained upon the stocks unfinished, until the expense of their maintenance exceeded several times their actual value. Robeson spent millions of dollars in repairing and rebuilding ships, and at the end of his administration had nothing to show for his work but an obsolete fleet in poor condition. Under him the two principal working bureaus of the Navy Department, Construction and Repair, and Steam Engineering, spent more than $6,000,000 a year. Under Thompson they spent about one-half of that sum. During the administration of the latter the condition of the fleet rapidly deteriorated. Moreover, Robeson could blink long stretches of authority, while Thompson refused to over-

[112] Hamersly, Naval Encyclopedia, 815; Evans, A Sailor's Log, 172-173.
[113] House Ex. Doc., 44 C., 1 S., No. 116.

look the plain letter of the law. Robeson, therefore, was able to add several new vessels to the fleet under the disguise of repairing old ones. In June, 1882, speaking of the navy under Thompson, Robeson said in a speech in the House of Representatives, of which body he was then a member, that $73,000,000 had been spent for the navy in the last five years and that not one ship had been launched, except the *Nipsic*, which he had finished, and not one new gun had been put afloat.[114]

Beginning in 1872 Robeson thoroughly overhauled fifteen or sixteen of the single-turreted monitors, dating from the Civil War. Some of their principal wooden parts were taken out and iron was substituted. This work went on in 1873 and 1874 under the added stimulus of the *Virginius* episode. A part of the $4,000,000 which Congress appropriated to meet the extraordinary expenses incurred at this time was used in the repairing of these ironclads. Robeson was much criticised for this expenditure as being a waste of money, but under the circumstances of the time it was proper and advisable. The repairs of these ironclads seem to have come within the law, notwithstanding that they were quite extensive.

Still more extensive were the "repairs" that Robeson made to certain old wooden ships. In this case his authority to perform the work is, to say the least, questionable. The "repairs" consisted of the construction of new ships under the guise of repairing old ones. Often it would have been more economical to have sold the old vessels, as it cost more to tear them up than their materials were worth. But under the circumstances such a disposition was wholly out of the question, for it involved the erasing of their names from the list of naval vessels, and these must be preserved at all hazards in order to maintain the fiction of making repairs. Robeson said that this method of repairing ships had been long followed by the department. The old historic ship *Constitution*, for instance, had several times been rebuilt in this way. Moreover, he conceived that it was to the navy's advantage, for in the end it obtained a new vessel, instead of an old one with innumerable patches. Granting this, it did, however, seem to be stretching the law almost to the breaking point, when the "repairing" of an old vessel, perchance at the time many miles away,

[114] Sen. Ex. Doc., 48 C. 1 S., No. 48; Congressional Record, XII, 5522.

was commenced by laying down a new ship of a somewhat different model from that of the old. Of course the great advantage of Robeson's system was that the navy acquired new vessels, notwithstanding Congress was unwilling to authorize them. To be repaired in this way Robeson selected a ship for each of the seven principal navy-yards: at Portsmouth, the *Marion;* Boston, the *Vandalia;* New York, the *Swatara;* Philadelphia, the *Quinnebaug;* Washington, the *Nipsic;* Norfolk, the *Galena;* and Mare Island, the *Mohican.* Several other vessels Robeson so thoroughly repaired that they lacked but little of being made into new ships. Of course this work was expensive. In the end you had a new ship, it is true, but one of an old and possibly obsolete model."[11]

On the recommendation of Robeson, Congress on June 23, 1874, authorized the Secretary of the Navy to use the balance of an appropriation for a floating dry dock, amounting to about $900,000, for the purpose of "completing the repairs" of four double-turreted monitors, *Miantonomoh, Monadnock, Terror,* and *Amphitrite.* These vessels, which were built during the Civil War, were considered very formidable ships and valuable for either coast defense or deep-sea navigation. The *Miantonomoh* had visited Europe, and the *Monadnock* had made the voyage to San Francisco by way of Cape Horn. Robeson decided to thoroughly "repair" them, putting into the new vessels but few materials of the old. The names of the latter, however, were to be carefully saved for the use of the new ships. Iron hulls were to be substituted for the old wooden ones. The new monitors were to be larger than the old, and were to be more heavily armored and to be fitted with better machinery. Robeson contracted with each of four private shipbuilders to build one of the new ships. He also concluded to "repair" the single-turreted monitor *Puritan,* the construction of which had been begun by John Ericsson in 1862, but had not been completed.

The Secretary of the Navy contracted with John Roach, a famous shipbuilder of Chester, Pennsylvania, to construct the new *Puritan* and *Miantonomoh.* To cut down the expense of building these two ships, he turned over to Roach the old *Puritan* and ten old monitors and steamships of little value. For the old iron in these vessels Roach allowed Robeson one and three-fourths

[11] Bennett, Steam Navy, 632-636, 647-648.

cents a pound. In a similar way the new *Amphitrite* and *Terror*, after swallowing up the original ships of these names, absorbed several other useless naval hulks. For this bartering of old ships, the Secretary of the Navy was severely criticised, and many members of Congress considered it illegal, since there was a law directing that the proceeds arising from the sale of old ships should be turned into the federal treasury. A legal disposition, however, did not serve the purpose of the Secretary, since thereby the navy would have lost the use of the old ship, the proceeds derived from its sale, and especially its name invaluable for keeping up the fiction of "making repairs." Robeson thought the end justified the means.

After its first appropriation of some $900,000 Congress refused to vote money for the reconstruction of the ironclads. Robeson, however, continued the work, as best he could, with money drawn from the appropriation for the "repair of ships." When Congress greatly decreased this appropriation the work on the five vessels came to a standstill. The Secretary of the Navy now resorted to a questionable expedient. On one of the very last days of his administration he contracted for the completion of four of the vessels on the condition that the government should not be bound to pay any money until Congress should appropriate it. The rescinding of these contracts, which were regarded as illegal, was one of the first acts of Secretary Thompson. Congress now proceeded to investigate Robeson's actions in respect to the five monitors, which for several years remained in an unfinished state in the yards of private builders at a heavy cost to the government for rent, and which were not completed until after Hayes's administration.[116]

Secretary Thompson, when new to his office, manifested a strong disposition to obey the letter of the law. Later, after he had felt the temper of Congress and had become aware of the exigencies of the naval service, he resorted to some of the expedients of his predecessor. In 1880 he drew upon the appropriation for the repair of ships in order to complete the construction of some of the "Robeson vessels" and to rebuild the *Lancaster*. Finally, even Congress sanctioned the expensive policy

[116] U. S. Statutes at Large, XVIII, 226; House Miscl. Doc., 45 C. 3 S., No. 21, 129-157; Bennett, Steam Navy, 628-629; Ann. Rept. of Sec. of N., 1877, pp. 28-30; House Rept., 45 C. 3 S., No. 112, 102-103.

of rebuilding old ships, although one of its investigating committees had condemned work of this sort for its extravagance. According to Robeson, he either built or effectively repaired forty-two ships. There was indeed real ground for his boast on the floor of the House in 1882 that "every ship that now floats bearing the American flag around the world, every ship that now carries a gun to respond to the demands of your government, was built, rebuilt or substantially repaired by me." For several years these "Robeson vessels" comprised almost the whole of the effective fleet of the United States.[117]

For building new ships under the guise of repairing them, for bartering old vessels on account of new, and for binding the government for the payment of money in excess of appropriations, Robeson was most severely criticised. By no means, however, did his critics stop at these alleged misdemeanors. He was accused of robbing the government in various ways, most especially by levying tolls on the contracts of the department for his personal use. It was said that he gave the navy contracts to favorites, that he maintained sinecures, and that he administered the navy-yards corruptly and inefficiently. He was charged with the illegal payment of old claims against the department and with various violations and evasions of the law; with purchasing naval materials in excess of naval needs; with great extravagance in the administration of the navy, and with manifold other frauds, errors, and abuses. For the last five years of his administration rumors of scandals in the Navy Department were current. These were zealously spread and amplified by the Democratic newspapers and the Democratic members of Congress. Whether true or false, they were eagerly pressed into partisan service.

Extensive investigations of Robeson and his administration were made by four committees of the House of Representatives: in 1872, 1876, 1878 and 1878-1879. The evidence taken, information ascertained and reports made by these committees consumed in printing 5675 octavo pages. The investigation of 1872 was made by a select committee, those of 1876 and 1878-1879 by the Naval Committee, and that of 1878 by the Committee on the Expenditures of the Navy Department. A majority of the members of the committees of 1876, 1878 and 1878-1879 were Demo-

[117] Congressional Record, 47 C. 1 S., XIII, 5693.

crats. By far the most extensive investigation was that of 1876. Its printed records contain 3745 pages. Seven sub-committees were appointed and the field of investigation was divided among them. The various navy-yards were visited and more than five hundred witnesses were examined. The hearings before this committee were for the most part not open to the public nor to the Secretary of the Navy.

The investigation of 1872 was undertaken by reason of a series of charges made against Robeson's conduct in office by the New York *Sun*. This newspaper accused him of robbery, theft, crookedness in awarding the naval contracts and other violations of law. It asserted that "this man is one of the greatest public robbers of the day," and that a "rough calculation shows that his robberies do not amount to less than $1,400,000." His frauds and robberies, said the *Sun*, are "almost innumerable." The editor of the accusing newspaper, Mr. Charles A. Dana, was invited by the investigating committee to appear before it and prove his charges. He was permitted to bring his counsel, to summon and examine witnesses, and to call for papers and documents. Dana himself testified before the committee, but he "totally failed to produce a single witness, or any proof whatever, tending in the slightest degree to maintain the charges he had made, or affect in any manner the personal or official character of the Secretary." Both the Democratic and Republican members of the committee exonerated Robeson from all charges of corruption, fraud and dishonesty. Two members of the committee, however, were of the opinion that the Secretary of the Navy had violated the law, and one of the Republican members considered Robeson's administration of the navy discreditable.[118]

The majority report of the investigating committee of 1876, containing 161 printed pages, was signed by seven Democrats and in a very qualified way by one Republican. It is a highly partisan document and was doubtless prepared with a view to its effect on the presidential election of that year. By means of copious extracts from the evidence and the liberal employment of such words as "frauds," "jobs," "fat contracts," "corruption," "abuses," "errors" and "violations of law," the majority of the

[118] House Miscl. Doc., 42 C. 2 S., No. 201; House Rept., 42 C. 2 S., No. 80; New York Sun, Feb. 17 to March 11, 1872.

committee gave in the body of their report the impression that Robeson was undoubtedly guilty of numerous crimes and misdemeanors. Yet, in conclusion, it merely submitted the rather innocuous resolution that the evidence and the whole subject be referred to the Committee on Judiciary "to examine and report whether such violations of the law as are referred to herein constitute and are impeachable offenses under the Constitution, and if so, then they shall report articles of impeachment against George M. Robeson, Secretary of the Navy." The Committee on Judiciary, a majority of whose members belonged to the Democratic party, allowed the matter to drop, and made no report to the House. It is said, however, that this committee found Robeson innocent of any criminal intent or corrupt motive. The minority of the investigating committee, consisting of three Republicans, presented a brief report, in which it replied to the arguments of the majority. It recommended the adoption by the House of the following resolution: "That in this investigation, no fraud, corruption, or wilful violation of the law has been shown or appears to have been committed by Hon. George M. Robeson while in the discharge of the duties of Secretary of the Navy; and we find no reason to censure or find fault with his conduct in the administration of the Navy Department."[119]

The investigation of 1878 was an inquiry into the contracts, accounts and expenditures of the department under Robeson. The investigating committee endeavored to find out the amount and the character of the department's indebtedness. It especially investigated Robeson's dealings in respect to the double-turreted monitors. The majority of its members, being Democrats, pronounced many of the acts of the Secretary of the Navy illegal; and the minority of its members, being Republicans, upheld him. The investigation of 1878-1879 in general covered the same subjects as those of 1876 and 1878. The Democratic majority of the committee severely condemned the Secretary of the Navy and the chiefs of the Bureaus of Steam Engineering, Construction and Repair, and Provisions and Clothing. The Republican minority reported that the "administration of the Navy Department by George M. Robeson and his subordinates, as shown by the testi-

[119] House Miscl. Doc., 44 C. 1 S., No. 170; House Rept., 44 C. 1 S., No. 784.

mony taken, is free from fraud, corruption and wilful violation of law." [129]

The findings of the committees of 1876, 1878 and 1878-1879, since their members invariably voted in accordance with their party affiliations, cannot be relied upon. The reports of the minority may be said to cancel those of the majority. The arguments of the reports, and no little of the evidence, being often contradictory, biased and extravagant, is inconclusive. It is not easy to determine what these voluminous investigations prove or disprove in respect to George M. Robeson and his administration of the navy. A few facts, however, are well substantiated. The civil service of the navy-yards was badly demoralized by politics. In making appointments Robeson was exceedingly responsive to the politicians. In many cases where the authority of the Secretary of the Navy was questionable, Robeson resolved the doubt in his own favor. In order to cover the exercise of a doubtful power he greatly stretched the statutes. His administration of the department was weak and extravagant. In the purchase of naval materials there was a considerable leakage of money. Wastes of this sort doubtless often occur. They were certainly greater under Robeson than they would have been under a capable and painstaking executive. That he in any way profited by virtue of his office, the evidence failed to prove. Robeson's relations with a broker, who made a fortune by obtaining naval contracts for himself and his friends, looked very suspicious. A committee of Robeson's political enemies, however, sitting in secret and examining many witnesses, failed to prove that his relations with this broker were corrupt. Robeson did not succeed in correlating the work of the bureaus, in closely supervising them, or in running the department as an efficient machine.

While many men became doubtful of the integrity and honesty of purpose of the Secretary of the Navy, and others were wholly convinced that he was guilty of theft and corrupt practices, he never lost the confidence of his political friends. Shortly after he left the Navy Department the leading Republican citizens of New Jersey tendered him a public dinner as a mark of their "appreciation of his official career and personal worth, and as congratulatory upon the success he had attained in the eminent public station

[129] House Rept., 45 C. 2 S., No. 787; House Miscl. Doc., 45 C. 2 S., No. 63; House Rept., 45 C. 3 S., No. 112; House Miscl. Doc., 45 C. 3 S., No. 21.

which he had so worthily filled." Senator James G. Blaine was present on this occasion.[121] General Grant regarded Robeson as an intimate friend, and during his memorable tour of the world wrote many letters to his former cabinet officer. In 1878 and again in 1880 Robeson was elected to Congress from New Jersey. During his second term in the national legislature he was one of the most influential members of the House.

Robeson always regarded the investigations of his administration of the navy made by the Democratic committees of the House as inspired by gross partisanship and even personal malevolence. He was especially bitter towards W. C. Whitthorne, of Tennessee, for a time chairman of the House Naval Committee during the naval administrations of Robeson and Thompson. In 1882, in a fierce outburst of feeling, he attacked, on the floor of the House, the personal character of Whitthorne and defended his own management of the navy. Speaking of the period of his administration, he said: "Congressional investigation, with unlimited powers for personal or for party purposes, were then the regular order of the day. Reckless men, inspired with brutish instincts, were clothed with extraordinary powers to penetrate every man's private life and throw open the penetralia of his family circle to the unholy inspection of the vulgar and the malevolent. The Navy Department, of which I was then the head, sustained the full brunt of the fiercest assault. Passing the sphere of legitimate investigation, its tide was turned against myself individually—my father's grave was dishonored, my mother's dowry inquired into, my wife's estate investigated, my children's portions examined. The details of my household life and expenses were under this—how shall I characterize it—most brutal proceeding, held up for the examination of the world."[122]

Offices that were wholly or partly sinecures seem to have flourished under Robeson's administration of the Navy Department to a greater extent than was usual. In Florida twelve agents were employed to guard the growing timber of the navy. Their salaries ranged from $40 a month to $1000 a year. They resided from fifty to one hundred miles from the reservations of timber, which

[121] Daily State Gazette, Trenton, N. J., July 3, 1877.
[122] Congressional Record, XIII, 5694.

none of them had ever seen. Henry Clews, one of the agents, testified before a committee of Congress as follows:

Question. "Are you a timber agent in Florida?"
Answer. "Yes, sir."
Question. "How far do you live from the timber you are expected to guard?"
Answer. "I do not know anything about the public domains, and did not try to find out."
Question. "Did you ever see or visit the timber?"
Answer. "No, sir."
Question. "Did you perform any service under that appointment?"
Answer. "No, sir; nothing but draw my pay."
Question. "What was your salary?"
Answer. "Forty-one dollars a month."
Question. "What is the politics of these agents?"
Answer. "They are Republicans."[122]

VI.

Naval Stations, Officers and Seamen, 1869-1881.

The investigation of the administration of Secretary Robeson made by the House Naval Committee in 1876 abundantly proved the baneful influence of politics upon the civil service of the navy-yards. It showed that immediately preceding important national or state elections hundreds of additional employees were temporarily employed at the yards. Work or so-called work was found for them until they had voted, and soon thereafter they were discharged. By the express command of Robeson, or the Navy Department at Washington, men were often employed against the wishes or recommendations of the commandants of the yards. The Secretary of the Navy sometimes abolished sinecures, but restored them in response to political pressure. It was common to assess the employees of the yards for political purposes. By virtue of his influence in the Navy Department at Washington the Congressman in whose district a navy-yard was situated exercised a large control in the appointment and retention of employees. Several yards were familiarly named for their controlling Congressman. For instance, the yard at Norfolk was

[122] Congressional Record, IV, 3259.

"Mr. Platt's yard"; and that at Mare Island "Mr. Sargent's yard." Sargent supervised his naval bailiwick so closely that he procured for a friend an appointment to the insignificant office of "bumboatman," thereby compelling the sailors to purchase their luxuries from his appointee.[124]

The decentralization of the administration of the yards in 1868 by the extension to them of the bureau system increased the political and decreased the naval element in their management. It diminished the power of the commandant and correspondingly increased the power of the bureaus. Vice-Admiral Rowan said that the bureau system "pulled out all the teeth of the commandant" and made him a sort of head postmaster, whose duty was to pass orders between the department at Washington and its representatives in the yards. However, a navy board appointed in 1869 reported that the extension of the bureau system to the yards had resulted beneficially.[125]

During the period of 1869-1881 the condition of the houses, shops, sheds, wharves, docks and machinery of the several navy-yards generally deteriorated. This was especially true under Thompson when the appropriations were much reduced. The expenditures for yards and docks under Robeson amounted to $18,714,000, most of which sum was used for repairs and maintenance, and very little for permanent improvements. The old yards, with their antiquated buildings and appliances, like the old ships, absorbed large sums of money, and in the end had little to show for their outlay. In 1872 the construction of a first-class stone dry dock was commenced at the Mare Island yard, but in a year or two the appropriations for this object were so small that the work languished, and in 1881 the dock was still far from completion. A few valuable buildings were erected at this yard. In 1871 a million dollars were appropriated by Congress for a floating iron dry dock, but Robeson considered this sum insufficient to build the structure, and eventually most of the money was used in rebuilding the double-turreted monitors.

Some permanent works were erected at the League Island navy-yard, which for several years after its acquisition by Secretary Welles remained unimproved. A plan for its development

[124] House Miscl. Doc., 44 C. 1 S., No. 170, parts 1, 2, 3, 4, 6, 7, 8.
[125] Ann. Rept. of Sec. of N., 1869, pp. 211-221.

was prepared in 1872 by a board of civil engineers, which was appointed for that purpose. The removal of the public property of the old Philadelphia yard to League Island was begun in 1873, and completed in the winter of 1875-1876. During the removal some of the property was lost, destroyed or stolen, and in the sale of some of the old materials frauds were perpetrated upon the government. Several of the officers who had charge of this work were blamed for a lack of dispatch and executive capacity. The old Philadelphia yard was sold at public auction in December, 1875.[126]

For a long time the removal of the New York navy-yard and the sale of its site were agitated in and out of Congress. Its occupation of valuable grounds in Brooklyn was considered adverse to the interests of that city. By its removal a large tract of land advantageously situated within the limits of the city would be opened up for purposes of residence or trade. The yard was said to be a nuisance, and an impediment to the growth of Brooklyn. The metropolitan newspapers zealously advocated the project. In 1871 the Naval Committee of the House reported a bill providing for the sale of the yard. At first, Robeson and several leading naval officers favored the proposal. They argued that the present site was too small, was incapable of adequate defense and was too near the distractions of a large city. When it appeared, however, that some of the men who were foremost in the agitation were quite willing to discontinue the yard before a new site was obtained, or to give up altogether the notion of having a naval establishment in the vicinity of New York, the Navy Department reconsidered the question and threw its weight against a change. This final stand of Robeson together with the opposition of the chief of the Bureau of Yards and Docks was largely instrumental in preventing the removal or discontinuance of the New York establishment. The friends of the measure, however, succeeded in 1877 in obtaining from Congress an authorization for the conveyance of a certain part of the yard to the city of Brooklyn for a public market.[127]

[126] House Rept., 44 C. 1 S., No. 784, pp. 118-125, 182-183.

[127] Ann. Rept. of Sec. of N., 1869, pp. 18, 73; 1870, pp. 11, 72; 1872, p. 67; 1873, p. 60; 1874, pp. 20, 75; 1877, pp. 20-21; Congressional Globe, 1870-1871, pp. 1063-1067, 1087-1092.

New London continued to urge upon the government her claims for a share of the naval appropriations. In 1870 the department established a naval station upon the site near this city which Secretary Welles had acquired two years before. In 1875 a board of civil engineers reported an elaborate plan for a navy-yard at this point. Since the number of yards was already excessive, the plan was not carried out. In 1873 a board of civil engineers prepared a plan for the improvement and development of the Mare Island yard. Both the Navy Department and Congress were now recognizing the increased importance of the navy to the Pacific states and the need of adequate facilities on the west coast for the repair and equipment of vessels. In 1880 the Naval Committee of the House reported favorably a resolution providing for a navy-yard on the coast of Oregon or Washington.

During the period of 1869-1881 considerable differences of opinion were manifested respecting the general policy to be pursued toward the navy-yards. Congress was strongly disposed to take the view that their number was excessive and that some of them ought to be abandoned. Toward the end of Robeson's administration it began to reduce the appropriations for them. On the other hand, the Navy Department again and again advised the expenditure of more money upon the yards, the erection within them of many needed improvements, their extension by the purchase of additional grounds, and the adapting of some of them to the construction of iron ships. In the spring of 1869, when Admiral Porter was the leading spirit in the department, he appointed a board of line officers, with Rear-Admiral C. K. Stribling as president, to consider the needs of the navy-yards. This board made an elaborate report, containing numerous suggestions respecting the improvement and organization of the chief naval establishments. It found most of the yards entirely too small, and recommended the enlargement of several of them. It did not propose the closing of any of them.[128]

During the seventies a sentiment developed in Congress in favor of closing several of the yards. In 1876 Congress authorized the appointment of a board of five naval officers to examine fully the navy-yards and determine whether any of them could be dispensed with and abandoned. The board was composed of Admiral David

[128] Ann. Rept. of Sec. of N., 1869, pp. 211-221.

D. Porter, Vice-Admiral Stephen C. Rowan and Rear-Admiral Charles H. Davis, a naval constructor and a naval engineer. It recommended that the "navy-yard" at New London should be abandoned, and that the remaining navy-yards should be "not abandoned or dispensed with." Since the establishment at New London was merely a poor and indifferent naval station, the retrenchment advised was a very slight one. The board did not recommend a suspension of any of the activities of the Portsmouth or Boston yards. In case, however, such suspension was for any reason made, it suggested that the two yards should be provided with a sufficient number of officers and employees to render them ready for any emergency. In no case should the ropewalk at the Boston yard be shut down. It recommended the improvement of the establishments at New York, League Island, Norfolk, Washington, Pensacola and Mare Island. The board was really opposed to any retrenchment, but it was disposed to yield something to a contrary sentiment in Congress. In view of the naval policy which Congress pursued for the next twenty years, it doubtless would have been wise to have concentrated the work of the navy at some two or three of the yards. Moved by its instincts for economy, a private corporation under similar circumstances would certainly have consolidated its business and reduced its expenditures.[129]

During the seventies not much was done for the improvement of the naval stations. For a time a small sum of money was spent at New Orleans. From 1861 to 1865 Port Royal, S. C., was one of the most important depots of the navy. During the early seventies it was practically abandoned, but in the late seventies it was revived. In 1876 a navy board considered the establishment there of a naval station. The station at Mound City, Illinois, which had been maintained since the war, was discontinued in 1875. The rivalry between towns for naval favors was not now so great as formerly. Mount Desert, Me., and St. Marys River, Md., however, were thought by interested persons to possess eligible naval sites. In 1880 Secretary Thompson reported that he had taken steps toward the establishment of coaling stations on each side of the Isthmus of Panama, and that he had directed the establishment of a station of this sort on the bay of Pago

[129] U. S. Statutes at Large, XIX, 66; House Ex. Doc., 44 C. 2 S., No. 8.

Pago, Samoa Islands, in accordance with a right granted to the United States under the terms of a recent treaty with those islands. In 1879 the administration of Alaska was assumed by the Navy Department.[130]

In 1869 a torpedo station was established on Goat Island, in Newport Harbor, under the Sperintendence of the Bureau of Ordnance. This island, which contains twenty-four acres, was acquired by the Navy Department by transfer from the War Department in July, 1869. The purpose of the station was to instruct naval officers in the manufacture and use of torpedoes. Its establishment was largely the work of Admiral Porter, and is one of the permanent achievements of his bold and radical administration of the navy. On June 9, 1869, he ordered Commander E. O. Matthews to report for duty under the Bureau of Ordnance as instructor of the torpedo corps of the navy. In the summer of that year Matthews located the site of the school, and in September took possession of Goat Island and commenced the erection of the necessary buildings. An old frame house was converted into a temporary machine shop, and a laboratory and magazine were constructed. A competent chemist was appointed to take charge of the laboratory. In the spring of 1870 the *Nina* was attached to the new station. The first class reported for instruction on November 1 of that year, and consisted of nineteen members. For several years the officers of the navy were not disposed to attend the school. They disliked to resume the tasks and requirements of their school-boy days, nor did they take kindly to the manual work of fitting, laying out and firing torpedoes. But in course of time the school became quite popular Under Robeson it gave instruction to 153 officers. The instructors were chiefly officers of the navy.[131]

Before and during the Civil War the experimental batteries of the Bureau of Ordnance, which were used in testing guns, gunpowders and fuses, and in fixing the ranges of guns, were located at the Washington navy-yard. Owing to the increasing commerce upon the eastern branch of the Potomac, over whose waters the guns were fired, and to the erection of new buildings near the

[130] Ann. Rept. of Sec. of N., 1880, pp. 25-26; Proceedings of U. S. Naval Institute, XVI, 2.

[131] Ann. Rept. of Sec. of N., 1869, p. 68; 1876, p. 113; Miscl. data, Bureau of Yards and Docks, 68-69; Hamersly, Naval Encyclopedia, 816.

navy-yard, these batteries had to be abandoned. The chief of the Bureau of Ordnance, after trying in vain to interest Congress and to obtain suitable grounds, erected an experimental battery in 1872 at Fort Madison near the Naval Academy at Annapolis. Here the proving-grounds of the navy remained for several years.[132]

Long before the Civil War naval magazines had been erected at Chelsea, Mass.; Fort Mifflin, Pa.; Ellis Island, N. Y.; and Fort Norfolk, Va. In 1873 a new site for the magazine of the Washington yard was purchased for $45,000. It contained ninety acres, and was situated on the Potomac about four miles from the yard. As early as 1846 St. Helena, lying opposite the Norfolk yard on the Elizabeth River, had been purchased for the storage of ordnance.[133]

During the fifteen years succeeding the Civil War the science of naval ordnance was being revolutionized. Rifles were displacing smooth-bores; breech-loaders, muzzle-loaders; and wrought-iron, cast-iron guns. The armament of ships was greatly increasing in power, and was getting the better of the armor. During this period the guns of the American navy fell far behind those of other nations. Some improvement, however, was made in the navy's small arms and light guns. Robeson reported that during his term of office a uniform system of breech-loading small arms had been introduced, and a supply of Gatling guns purchased. He said that he had endeavored to "lay the foundation of a general system of progress in our ordnance." In 1879 Hotchkiss rifles were issued to some of the ships. The department was also making a slight improvement in its heavy guns. It was converting some of the old ante-bellum smooth-bores into rifles, and the old muzzle-loading Parrott's into breech-loaders. How weak the navy was in effective, up-to-date cannon may be seen from a report of a committee of the House made in 1880: "We have less than 250 guns afloat in our entire navy, and of these less than 40 are rifles (a few 8-inch, a few 100 pounds, and a few 60 pounds), all the rest are antiquated smooth-bores." The chief of the Bureau of Ordnance believed, however, that we had lost little or nothing by the delay in procuring new guns, and that "there

[132] Ann. Rept. of Sec. of N., 1872, p. 51.
[133] Miscl. data, Bureau of Yards and Docks, 18.

would be the same outcry of inefficiency if the navy were armed with the best breech-loader of five years' date"—such were the rapid advances being made in the art and science of naval armament. He also said that such cannon as the navy required could not be built by the steel manufacturers of the United States.[134]

The scientific work of the navy from 1869 to 1881, while not so brilliant as that of the period preceding the Civil War, was quite creditable. During the early seventies the personnel and work of the Hydrographic Office was gradually increased. Important hydrographical surveys were made in the Pacific Ocean and the West Indies and along the coasts and up the rivers of South America. Some deep-sea explorations in the Pacific were undertaken. During the first years of Robeson's administration the navy made several important surveys of canal routes across the Isthmus of Panama and Central America. Two Arctic expeditions were sent out under the direction of the Secretary of the Navy—the *Polaris* expedition in 1871, and the *Jeannette* expedition in 1879. The eighth decade of the nineteenth century was an important period in the history of the Naval Observatory. It was marked by the purchase of the largest telescope in the world, the discovery of the two satellites of Mars, and the observations of some notable solar eclipses and of the transit of Venus. In 1880 Congress decided to erect a new observatory on a new site.

In the early seventies the instruction of the naval engineers was made a permanent part of the work of the Naval Academy. In 1879 the department wisely decided, in view of the great changes taking place in naval architecture, to select each year from the most promising graduates of the academy a few students to pursue post-graduate work in naval construction at the best schools abroad, especially those at Greenwich, Paris and Glasgow. Cadet-Engineers F. T. Bowles and Richard Gatewood were the first graduates to avail themselves of this privilege. Bowles has attained great distinction in his profession, and has served as Chief of the Bureau of Construction and Repair. He resigned from the navy to accept a lucrative and responsible office with one of the great ship-building companies.

Throughout the administrations of Grant and Hayes members of Congress continually asserted that the number of naval officers

[134] Ann. Rept. of Sec. of N., 1876, p. 20; 1880, p. 79; House Rept., 46 C. 2 S., No. 169, p. 12.

was excessive, and they made frequent attempts to reduce it. In 1877 the active list and the retired list of the navy contained, respectively, 829 and 135 line officers, 594 and 107 staff officers, and 249 and 27 warrant officers. All told, the active list consisted of 1672 officers; the number of enlisted men at this time was 7012. That is, there was one officer for every 4.2 seamen—a greater ratio than obtained in either the British or French navy. Measured by its needs in time of peace, the navy undoubtedly contained an excess of shoulder straps.

In 1870, in accordance with the recommendations of Robeson, Congress made important reductions in several grades, while at the same time the number of lieutenants was considerably increased. In 1871 Robeson recommended that the grade of commodore be dispensed with, and that the offices of admiral and vice-admiral be permitted to lapse on the death of their present incumbents. Accordingly, Congress, in 1873, passed a law providing that vacancies in these two latter grades should not be filled. The office of vice-admiral lapsed on the death of Vice-Admiral Rowan in 1890, and that of admiral on the death of Admiral Porter in 1891.

The naval appropriation act of 1870 provided a new pay-table, which raised the pay of officers at sea about twenty-five per cent, but in general lowered their shore-pay. The admiral of the navy was now given an annual salary of $13,000. The sea-pay of the vice-admiral was fixed at $9000, a rear-admiral $6000, commodore $5000, captain $4500, commander $3500, and midshipman $1000. The chiefs of bureaus were given the pay of commodores on shore duty.[126] The pay of the officers and seamen of the navy in 1870 was about $2,500,000 more than in 1860. This was one, although by no means the chief, source of the large increase in the naval expenditures during Grant's administration as compared with those under Buchanan.

During the twenty years succeeding the Civil War the naval service did not offer an inviting career to the ambitious and energetic officer. It was never more dull and enervating than at this time. It presented all the dreary monotony and mechanical grind of a socialistic regimé without any of the latter's promised

[125] Ann. Rept. of Sec. of N., 1871, p. 16; 1877, p. 7; Congressional Record, VII, 1952; VIII, 627.

[126] U. S. Statutes at Large, XVI, 330.

equity and elevation of ideals. Promotions from grade to grade were exceedingly slow. The "naval hump," caused by the admission of so many young officers during and immediately after the war, effectively blocked all below it. There were lieutenants in 1869 who were still lietuenants in 1881, and the same condition held in the grade of lieutenant commander. It was charged that examinations for promotions were often a farce, and that incompetent men were passed without question. Politics contributed its share in bringing about this unfortunate condition. By means of acts of Congress officers who had been for years on the retired list suddenly appeared in their old places again, and other officers who had been dismissed from the navy by courts-martial were restored to their former positions.[137]

Early in Grant's administration the smouldering quarrel between the line and the staff over questions of rank flamed out again with increased heat. The principal cause of the renewal of the controversy was the revocation by Porter and Borie of Welles's order of March 13, 1863, fixing the rank of the staff. This revocation followed a decision of Attorney-General E. R. Hoar that Welles's order was in certain respects illegal. The "degradation" in rank caused by the rescinding of the order was considered very humiliating by the staff. It involved no loss of pay, but it entailed the removal of stripes and other insignia of rank from their uniforms, and the substitution of the marks of the inferior grades. For instance, the fifteen surgeons who had ranked as captains were reduced to the grade of commander. Attempting to quiet the commotion Robeson, in November, 1869, appointed a board to consider the subject. It consisted of the eight chiefs of bureaus and of two additional officers, one of the line and the other of the staff, and was presided over by Commodore Melancthon Smith. On January 24, 1870, a majority of the board made a report fixing the "relative rank" of the several grades of staff officers in accordance with a prescribed scale. It should be said that the term "relative rank" had now come to be used in place of the former term "assimilated rank." Robeson took the side of the line and made recommendations to Congress that were less liberal to the staff than those of the board.

The controversy was carried on in Congress as well as in the department and the navy, and its members were copiously supplied

[137] International Review, March, 1879, pp. 280-281.

with literature on the mooted subject. Even before the rescinding of Welle's order the medical corps had gone to Congress to obtain desired legislation, and a bill had been introduced granting the naval surgeons "positive rank." This was a still higher grade of that impalpable and greatly coveted possession of the line, and the whole naval staff now set their hearts upon obtaining it. The House favored the cause of the staff and the Senate that of the line. The House passed a bill granting the staff "positive rank." The Senate stood out for merely increased "relative rank," which the line agreed to yield. The Senate won, and the staff was greatly grieved at the result. The flame of the unending controversy died down, but continued to smolder.[138]

In Robeson's administration until June 20, 1876, the number of seamen in the navy, as fixed by Congress, was 8500. In the winter of 1873-1874, owing to the difficulty with Spain over the *Virginius* affair, this number was temporarily raised to about 10,000. At the beginning of the fiscal year 1877, in accordance with an act of Congress, the number of the enlisted men of the navy was reduced to 7500. In 1878 the seamen in the navy proper did not greatly exceed 6000 men. The rest of the total quota were either boys, or else seamen employed in the Coast Survey, the Naval Academy or Fish Commission. The enlisted force of the navy probably had not been as low since the administration of Andrew Jackson. In May, 1879, Congress authorized the employment of 750 boys, increasing the total quota to 8250, at which figure it remained for several years. In 1874 Congress limited the number of privates in the marine corps to 1500.

Admiral Porter said that, owing to the introduction of steamships, the quality of the sailors of the American navy steadily declined from about the time of the Mexican War, and that "until 1846 we possessed, for the limited number of ships in our navy, the finest body of seamen in the world." He was of the opinion that the employment of sailors in coaling ship and hoisting out ashes caused a decadence in their character. Porter, who was a great lover of sailing vessels, probably exaggerated the influence of steamships upon the American sailor. The decline of the merchant marine, which, as everyone knows, was greatly accelerated

[138] Congressional Globe, 1870-1871, pp. 678, 1844; House Ex. Doc., 41 C. 2 S., No. 99; House Miscl. Doc., 41 C. 2 S., No. 33; speech of A. F. Stevens in the House, Jan. 23, 1871.

by the events of the Civil War, had much to do with the impairment of the quality of the enlisted force of the navy. After the war the department, in order to obtain recruits, was compelled to draw more and more from those seafaring waifs that frequent the various ports of the world. Seamen of American parentage or nationality were not to be had. In 1876 or 1877 the executive officer of an American sloop-of-war on the China station prepared an analytical report of the crew of his vessel. Of the 128 men on board, 47 were Americans, 21 Chinamen, 20 Irishmen, 9 Englishmen, and the rest Swedes, Danes, Germans, Scotchmen, Greeks, Brazilians, French, Indians, Peruvians, Russians, Hawaiians, Welshmen and natives of the West Indies, Azores, Jersey, Liberia, Newfoundland and Nova Scotia. Twenty-two countries were represented. Admiral Porter is responsible for the story that during the seventies or thereabouts an American sloop-of-war with a cosmopolitan crew was anchored in the harbor of Villefranche. The crew represented nineteen nationalities, and so little American was it in appearance that some wag painted on board and hung in the gangway of the sloop the words *"ici on parle Anglais,"* like the signs displayed in the shops of Paris.[139]

The scarcity of good seamen led the department to undertake again the training of young men for the naval service. The apprentice system had been tried several times, but had failed. Secretary Welles's attempt, which was the last one, was abandoned because the reduction by Congress of the number of the enlisted force to 8500. The need of seamen was so great that it was impossible to include in this number any boys. It is said also that the illusive hope of entering the Naval Academy that Welles presented to the apprentices was injurious to the system. Admiral Porter again and again recommended the establishment of a new apprentice system. Finally, in April, 1875, Secretary Robeson ordered the enlistment of a limited number of apprentices. By October two hundred and sixty boys were under instruction, and training ships had been established at the New York, Portsmouth and Mare Island navy-yards. In accordance with the new system, the boys were first given preliminary instruction on ships in port, and later were sent to sea in training-

[139] Ann. Rept. of Sec. of N., 1870, p. 158; 1888, pp. 8-12; International Review, 1879, p. 378.

ships and were taught seamanship, gunnery, and the practical arts of the naval craft. In 1880 the training squadron comprised some three or four vessels. In June of that year 1168 boys were in the naval service. In May, 1879, Congress recognized the new system by authorizing the enlistment of 750 boys. It proved quite successful, and is said to have met the most sanguine expectations of its friends. Its development was greatly furthered by Captain Stephen B. Luce, who for some years commanded the training squadron. For a time Admiral Porter exercised a general supervision over the apprentices.[140]

In December, 1880, a board of naval officers, of which Commodore Earl English was president, examined the naval station at New London, and also Coasters Harbor Island at Newport, with a view to locating a naval training station. Much to the regret of New London, the board chose the latter site. Coasters Harbor Island is situated near Newport, not far from the torpedo station on Goat Island, and contains ninety-five acres. On March 2, 1881, it was ceded to the United States by Rhode Island, and on August 26, 1882, Secretary of the Navy Chandler took formal possession of it. Captain Luce was the first commandant of the new station.[141]

By the end of the seventies several states had come to take a considerable interest in the training of seamen. Massachusetts had fitted out two ships for the instruction of boys in the arts of the sailor. New York had passed a law establishing a nautical school for the education and training of youths in the science and practice of navigation. To aid schools of this sort, Congress in June, 1874, passed the marine school bill. This authorized the Secretary of the Navy to furnish, under certain conditions, a vessel for the use of a nautical school at any one of the following ports: Boston, New York, Philadelphia, Baltimore, Norfolk and San Francisco. The vessel was to be equipped with all her apparel, charts, books and instruments of navigation. To be eligible to receive a ship a school must teach navigation, seamanship, marine engineering and all matters pertaining to the

[140] Ann. Rept. of Sec. of N., 1875, pp. 18, 85; 1880, 106-107; Hamersly, Naval Encyclopedia, 521-522.

[141] Congressional Record, XI, 1566; Miscl. data, Bureau of Yards and Docks, 66; R. I. Acts and Resolves, Jan., 1881, p. 101.

proper construction, equipment and sailing of vessels.[142] The President was authorized to detail naval officers as superintendents or instructors.

VII.

THE NAVY DEPARTMENT, 1881-1897.

With the Garfield-Arthur administration the navy and the department entered upon a new era. They now shook off the lethargy that fell over them soon after the Civil War. The public manifested a growing interest in the national marine. The politicians regarded it with increasing favor. Each of the two leading political parties came to advocate the building of new and larger ships, and, when once this work was under way, they vied with each other in carrying it forward. With the rehabilitation of the navy the current of naval affairs, both in the Navy Department and in Congress, deepened and widened. The navy assumed an importance that it had not known since the Civil War, and the naval committees of Congress became strong forces in national legislation and administration.

From 1881 to 1897 "the building of the new navy" was by far the most important work of the department. To this enterprise all other naval activities and interests yielded. It gives color, so to speak, to the naval history of this period. Questions relating to the naval personnel, it is true, were debated and agitated, and some attempts were made to settle them, but they were for the most part postponed. They were not so impersonal as were the questions relating to the matérial, and were therefore not so easy of solution. Then, too, the most pressing need of the navy was for modern vessels equipped with up-to-date guns and mechanisms. During these years the personnel and administrative machinery of the department were gradually increased, and the problems of naval administration more and more attracted the attention of the Secretaries of the Navy.

The increased work and importance of the Navy Department called for more efficient Secretaries than had been needed, or had been obtained, during the years of naval decadence. The Secretaries from 1881 to 1897 displayed a larger industry, more aptitude for naval affairs, and greater zeal for administrative reform

[142] U. S. Statutes at Large, XVIII, 121; Hamersly, Naval Encyclopedia, 521.

than did their immediate predecessors. Indeed, it would be difficult to find another period of equal length since the founding of the department when the navy was better managed—although perfection in its administration was by no means reached. During peace, with the possible exception of the years since 1898, at no time in our history have the naval executives had as good opportunities to distinguish themselves, whether in the building of new ships, the manufacture of warlike materials, or the improvement of naval administration, as during the period when the foundations of the new navy were being laid. This consideration, together with the fact that the term of office of the five Secretaries during the years 1881-1897 was longer than the average term, may account for their relatively successful administrations.

Since the founding of the department in 1798 those Secretaries of the Navy who have served for only some twelve or eighteen months have generally had little permanent or positive influence on naval administration. At least a year is necessary for a civilian to familiarize himself thoroughly with his duties and to acquire a working knowledge of the navy. The short-term Secretaries usually do little more than learn the routine of their office, render a few decisions at the bidding of their subordinates, and vex, through lack of knowledge or misplaced zeal, the already troubled waters of the navy. Of all the departments of the government the Navy Department is the most difficult for a lawyer and politician to administer. The navy has its own ways of thinking, standards of value, customs, traditions, prejudices and eccentricities. Of these a new Secretary is often wholly ignorant. Moreover, the Navy Department does a most complicated business relating to manufacturing of various sorts, naval architecture, steam engineering, scientific enterprises, naval education, the science and practice of war, naval and international law, diplomacy, medicine and surgery, finance and accounts, astronomy, and hydrography. In addition to knowing something about these subjects, which by no means exhaust the list, the Secretary of the Navy must have such knowledge of political affairs as will fit him for a seat in the cabinet among the President's political advisers. It is also likely that he will be encumbered with various formal duties of an official or social character. Indeed, his duties, both actual and potential, continually tend to become more numerous, complicated and technical.

Each of the five Presidents of the period 1881-1897 appointed a single Secretary of the Navy. The administrations of the several Naval Secretaries cover about the same period as those of their respective chiefs. Garfield's Secretary, William H. Hunt, of Louisiana, however, held office for several months under Arthur. On April 17, 1882, Hunt was succeeded by William E. Chandler, of New Hampshire. The Naval Secretary during Cleveland's first administration, 1885-1889, was William C. Whitney, of New York; and during his second, 1893-1897, Hilary A. Herbert, of Alabama. Harrison's Secretary of the Navy was Benjamin F. Tracy, of New York. He served for the period 1889-1893. Hunt, Chandler and Tracy were Republicans, and Whitney and Herbert Democrats. Chandler, Whitney and Tracy were Northerners, and Hunt and Herbert, Southerners. Each of the five men had been bred to the law. Only Herbert had served in Congress before entering the Navy Department.

Doubtless it is too soon to render a final judgment upon the services and characters of these men. Each was greatly interested in the reconstruction of the navy, and, no matter what his politics, earnestly carried forward the shipbuilding program of his predecessor. Each made some change or reform in the administrative machinery of the department. Mr. Charles H. Cramp, the shipbuilder, awards the palm of ability and efficiency to Whitney and Tracy. Of the five Secretaries, Chandler and Whitney were the most aggressive and positive, and the most ardent for naval reform; they were men of courage, and were willing, if necessary, to stem the tide of naval or political influence. Both were real heads of the department, and exercised more power than any of their predecessors since Gideon Welles. Chandler had had some acquaintance with naval affairs and with federal administration. For a short time, in 1865, he served as solicitor and judge-advocate of the navy, a position that he resigned to become Assistant Secretary of the Treasury. He was industrious, accurate and self-willed, and determined to rule in the department. Whitney, on the other hand, was more tactful and adroit, although a most direct and energetic man. He had had some experience in the municipal administration of New York City.[148]

In 1885, when Whitney was entering upon his duties, he was described as a "youthful looking and handsome man. He wears

[148] Army and Navy Journal, XX, 379; Buell, C. H. Cramp, 172-192.

glasses and his clothes fit 'like the paper on the wall.' No one has ever yet complained that Mr. Whitney equivocated. In this respect he resembles Ex-Secretary Chandler, who had the tact of making the bluntest, plainest and clearest statements in relation to matters in the Navy Department of any Secretary who has been in office since the war. Mr. Whitney is a good deal like Mr. Chandler in some other respects. He is quick, nervous and alert, and has the gift of instantly seeing the main point at issue, no matter how much it is covered up with a mass of details, and the courage to speak out his mind at once." [144] He was a most efficient Secretary, and was generally popular among the naval officers—a rare distinction. The "Prince of Secretaries," Rear-Admiral Evans has called him. So important was his administration that he has come to be popularly, though erroneously, regarded as the "Father of the New Navy."

Secretary Hunt was inclined to depend more upon his bureau chiefs for direction than were his two immediate successors. He was a native of Charleston, South Carolina, and was of Whig stock. His mother, whose family name was Gaillard, was of French extraction. He is described as being very much unlike an American in appearance, of "swarthy complexion, very marked features, and resembling much the races of Southern Europe. He is courtly—perhaps a little precise—in his manner, and he has always been considered a man of the greatest integrity." [145] He became Attorney-General of Louisiana in 1876, and Judge of the United States Court of Claims at Washington in 1878. Hunt will always be remembered as the Secretary of the Navy who initiated the movement for the construction of the new navy.

Tracy and Herbert were men of solid, rather than brilliant, parts. They performed their duties faithfully and efficiently, and without bluster. They were by profession lawyers. During the Civil War Tracy won the title of brigadier-general. He was severely wounded in the Wilderness campaign of Grant. In 1881-1882 he was Associate Justice of the New York Court of Appeals. Herbert saw service in the Confederate Army, where he rose to the rank of colonel. He also was wounded in the Wilderness campaign. He was a representative in Congress from 1877 to

[144] Army and Navy Journal, XXII, 958.
[145] Army and Navy Journal, XVIII, 687.

1892. At the time of his appointment he was one of the best qualified men in his party for the Naval Secretaryship, for he had taken a more prominent part in obtaining the legislation for the rebuilding of the navy than any other Democrat in the House. He was chairman of the House Committee on Naval Affairs in the 49th, 50th and 52d Congress, and was a prominent member of that committee in the 51st Congress when the Republicans were in control.

It is recollected that the office of Assistant Secretary of the Navy was established in 1861 at the outbreak of the Civil War, and that after it had been most acceptably filled by G. V. Fox and William Faxon, it was discontinued in 1869. In 1882 a movement for its re-establishment was started. In March of that year a bill providing for an Assistant Secretary of the Navy was introduced in Congress. At first it received the support of Secretary Hunt, but later he changed his opinion in respect to it. Secretary Chandler throughout his administration recommended the passage of some measure of this sort. He thought that one or more Assistant Secretaries were necessary in order to enforce the civilian control of the navy and to represent adequately popular ideas in the department, and he argued that the civilian element in the department should be strengthened to the extent that it would form a counterpoise to the predominating "naval" element. Senator Hale, of Maine, who for many years was the chief authority in the Senate on naval affairs, had often expressed the same view. For instance, in 1886 he said that the Navy Department needed a "further infusion of civilian or business experience and competency." One discovers in these opinions of Chandler and Hale an outcropping of the rivalry and antagonism that has always existed between the civilian and "naval" elements in respect to the management of the navy. The proposal to appoint an Assistant Secretary was not favorably regarded by the "naval" element.[146]

One of the clauses of an act of Congress approved on August 5, 1882, making appropriations for the civil establishments of the government, made provision for an Assistant Secretary of the Navy. He was to receive an annual salary of $3500. To obtain first-rate talent for so small a sum was difficult. Before Chandler

[146] Congress Letters, Navy Dept. Arch., XVII, 181; Congressional Record, XIII, 2297; XVII, 1122; Ann. Rept. of Sec. of N., 1883, p. 15.

was able to find such a man as he desired Congress, in March, 1883, repealed the provision creating the office. During the eighties various other attempts were made to provide the Secretary with an assistant. Finally, a provision for one was inserted in the bill of July 11, 1890, making appropriations for the civil establishments of the government. According to its terms, the new officer was to be appointed by the President from civil life, and was to receive an annual salary of $4500. This statute did not prescribe his duties. An act of March 3, 1891, assigned to him such duties "as may be prescribed by the Secretary of the Navy or required by law."[147]

On July 16, 1890, President Harrison appointed to the new office James Russell Soley, of Massachusetts. At the beginning of Cleveland's second administration, in 1893, Soley was succeeded by William McAdoo, of New Jersey, who served until his successor was appointed in 1897, early in the first administration of President McKinley. Both Soley and McAdoo possessed some admirable qualifications for the Assistant Secretaryship. Soley had what few civilian administrators ever obtain, an intimate knowledge of the military and administrative history of the navy and a familiarity with the habits of thought and action that exist in the naval service. From 1873 to 1882 he was head of the department of English studies, history and law at the Naval Academy, and from 1882 to 1890 he served as the librarian of the Navy Department in Washington. During the larger part of the latter period he was also superintendent of the Naval War Records Office, which he organized. From 1876 to 1890 he was professor in the navy, rising to the relative rank of commander. Soley had written several books treating of naval history, and he had lectured on international law at the Naval War College. McAdoo had formerly been associated with his chief, Secretary Herbert, as a member of the House Naval Committee, and had acquired some knowledge of naval affairs.

The "office of the Assistant Secretary" is attached to the Secretary's office, of which it constitutes a rather small part. The duties of the Assistant Secretary are not prescribed by law, but are fixed by the orders of the Secretary. They have, therefore, varied from time to time. In general they have consisted

[147] U. S. Statutes at Large, XXII, 243, 340, 550; XXVI, 254, 934.

of the odds and ends or detached parts of the naval business. They relate to miscellaneous matters, which, while by no means unimportant, are more or less subordinate to the main current of naval affairs. On the absence of his chief the Assistant Secretary acts as the Secretary of the Navy. He and the chief clerk of the department are the principal civilian advisers of the Secretary. Soley assisted Secretary Tracy in improving the methods of naval administration. McAdoo exercised a general supervision over vessels undergoing repairs, vessels under construction in the navy-yards, boards of survey and other naval boards, the departmental printing, the Office of Naval Intelligence, library of the department, Naval War Records Office, Naval War College, marine corps and naval militia.[148]

During 1881-1897 the Navy Department greatly increased its facilities for collecting and disseminating naval information of all sorts. On March 23, 1882, Secretary Hunt established the "Office of Intelligence" in the Bureau of Navigation for the purpose of "collecting and recording such naval information as may be useful to the department in time of war, as well as in peace."[149] One of the main duties of the new office was to collect information relating to foreign navies. That this was by no means a new idea is shown by the following extract taken from a letter of Secretary of the Navy Samuel L. Southard, dated January 26, 1827, to the American Minister to Great Britain. A similar letter was sent to the Ministers or representatives of the United States at St. Petersburg, Stockholm, Paris, Madrid, Lisbon, Algiers, Mexico, Guatemala, Bogota, Lima, Valparaiso, Buenos Ayres and Rio Janeiro:

> It is an object of great interest with this department to have accurate information of everything connected with the naval force of other nations; and important benefits may result from your kindness and attention to my wishes on this subject. May I, therefore, beg the favor of you, from time to time, to communicate to me such information respecting the naval force of Great Britain, or other nations, as you may be able to procure without inconvenience; especially respecting the number, situation, use, and employment of their vessels, the number, character, etc., of their navy and dock yards; the number and mode of furnishing their seamen; the means of educating their officers; the amount and character of the expenditures; and, generally, anything which will enable this department completely to com-

[148] Army and Navy Journal, XXXIV, 579-580.

[149] General Orders of the Navy Department, No. 292.

prehend the extent and character of the naval means of the nation. Copies of the annual detailed estimates for the service would be useful.[150]

The new office was soon called the "Office of Naval Intelligence," a term probably derived from the British "Department of Naval Intelligence." In 1883 its personnel consisted of Lieutenant T. B. M. Mason and nine junior officers. The agents of the office residing abroad are called naval attachés, and are connected with the American embassies or legations. The first American naval attaché, and for a time the only one, was Lieutenant-Commander French E. Chadwick, who performed his duties with great satisfaction to the department. In 1889 Secretary Tracy wrote that Chadwick's "extraordinary ability and judgement during six years of difficult service in England and on the Continent had a lasting influence upon the naval development of this country."[151] In 1896 there were three naval attachés, and they were assigned to European countries. Shortly after its organization the office began the publication of two series of valuable reports, one relating to naval operations in recent wars, and the other to general professional information. It soon made itself indispensable to the work of the department, the navy, and even the naval committees of Congress. It prepares reports on the ship-building programs of foreign countries, foreign naval statistics and news, recent developments in naval science and recent operations in naval wars.

A work in some respects similar to that of the Office of Naval Intelligence has for several years been conducted by the Library of the Navy Department and the Naval War Records Office. The chief purpose of each of these organizations is to render naval information accessible to the navy and the department. The library performs this function by collecting books relating to naval and kindred subjects. The bureaus and offices of the department also have libraries, but the main library is larger than all of these local libraries combined; and its contents, as a whole, are of a more general character. Its history begins with the collection of books which was made by the early Secretaries of the Navy. In 1820-1830 the Secretary's office and the Navy Commissioners' office were spending for books about two hundred dollars a year each. In the early eighties the books of the Secre-

[150] General Letters, Navy Dept. Arch., XVI, 14-15.

[151] Ann. Rept. of Sec. of N., 1889, p. 7.

tary's office and those of the bureaus that were of a more or less general character were deposited in the library-room of the new Navy Department Building, and they became the nucleus of the present library. The organization of the library may be dated with the appointment of Professor J. R. Soley, in 1882, to be librarian. The number of books increased from about 10,000 volumes in 1883, to about 30,000 volumes in 1896.

Soon after Soley became librarian he began to arrange the official records of the Union and confederate navies preparatory to their publication. This enterprise was heartily encouraged by Secretary Chandler, and elicited much interest on the part of historians and naval officers. Not much was done, however, until the latter part of 1884. On July 7 of that year Congress appropriated a small sum of money for the employment of a few clerks to copy and classify such naval documents as were available from the files of the department or could be obtained from other reliable sources. Professor Soley was made superintendent of the Naval War Records Office, as the new division which took charge of this work was called. He served until 1890, when he became Assistant Secretary of the Navy. He was succeeded by Lieut. Commander F. M. Wise, who, like Soley, also served as librarian of the department. Since the work of the records office and the library is somewhat similar, a single chief has always presided over both organizations. Several years elapsed before the appropriations for the new records office were large enough to insure rapid advancement of its work. In 1894 the first volume of the "Official Records of the Union and Confederate Navies in the War of the Rebellion" was published. This relates to the operations of the cruisers of the two belligerents during 1861 and 1862. Additional volumes of a somewhat similar character have appeared from time to time. In recent years the office has been ably conducted by Mr. Charles W. Stewart, a graduate of the Naval Academy of the class of 1882.[152]

On January 6, 1887, Secretary Whitney established the office of naval inspector of electric lighting in the Bureau of Navigation, a name which was later changed to the office of inspector of electrical appliances. In 1889 it was transferred to the Bureau of Equipment. This office is quite small, and is always presided over

[152] Official Records, ser. I, vol. 1, vii-xi.

by an officer of the navy. Its duties are to prepare detailed specifications for installing ships of war and naval stations with electrical appliances, and to inspect electrical materials and machinery before and after their installation.[153]

The Secretaries of the Navy have at different times tried to obtain legislation directing the transfer to the Navy Department of the several bureaus and offices of the Treasury Department whose duties are similar to those of the navy. They have argued that this work could be performed more economically and appropriately by the navy and its department, and that the inconveniences of detailing naval officers to duty in the Treasury Department should be avoided. Secretary Chandler, who was especially interested in increasing the duties and functions of the Navy Department, recommended that all national work on the ocean should be performed by the officers of the navy. He said that an "extension of the field of naval employment would strengthen and invigorate the service without any detriment to existing interests, while the fusion of all branches of nautical administration would secure concentration of purpose, unity of action, and broader and more substantial results." His plan involved the transfer to the Navy Department of the Light-House Service, Coast and Geodetic Survey, Revenue Marine Service, Life Saving Service, and all bureaus or offices of the Treasury Department whose duties related to the mercantile marine. He proposed to organize in the Navy Department a "bureau of mercantile marine," which should take charge of this branch of the national administration. One of its principal aims was to be the revival of the rapidly decaying American marine. So extensive a plan was doomed to fail. Such is the interest of individuals, classes and parties in the maintenance of the existing illogical distribution of duties among the several executive departments, that it is almost impossible to effect the redistribution of those duties in a logical manner.[154]

During the period 1881-1897, when the first vessels of the new navy were built, the work of the Bureaus of Construction and Repair, Steam Engineering, Ordnance, and Equipment—the four manufacturing bureaus—greatly increased in magnitude and importance, and became more highly specialized, technical, detailed

[153] Ann. Rept. of Sec. of N., 1887, p. 157.

[154] Ann. Rept. of Sec. of N., 1883, pp. 32-42; 1884, pp. 46-49.

and complicated. These bureaus manage large manufactories, design complicated ships, guns and machinery, and inspect the manufacture of ordnance, steel, gun-forgings, armor-plate, engines and naval supplies. The character of their work is "civil" rather than "naval." They conduct a manufacturing, engineering and mechanical business. It has been remarked that the point of view of line officers who serve in these bureaus for a long time is likely to become assimilated to that of the civilian or the mechanical engineer. Such line officers may even become deficient as naval executives on shipboard, and may in a measure lose their taste for the sea and a purely naval life. Their outlook on their profession, however, is greatly broadened, and they come to realize adequately that the mechanical and engineering sciences more and more condition modern naval warfare. Naval routine and traditions appear to them less significant.

The two naval constructors who had charge of the Bureau of Construction and Repair when the first vessels of the new navy were built were Chief Constructor Theodore D. Wilson, 1882-1893, and Rear-Admiral Philip Hichborn, 1893-1901. Engineer-in-Chief Charles H. Loring, 1884-1887, and Rear-Admiral George W. Melville, 1887-1903, presided over the Bureau of Steam Engineering during this important period. Several illustrious officers served in the Bureau of Equipment. Its chief from 1884 to 1889 was Commodore Winfield Scott Schley, from 1889 to 1893 Commodore George Dewey, and from 1893 to 1897 Commodore French E. Chadwick. The manufacture of the new ordnance of the navy was conducted by three efficient chiefs of the Bureau of Ordnance—Commodores Montgomery Sicard, 1881-1890; William M. Folger, 1890-1893; and William T. Sampson, 1893-1897. Several of these chiefs served for more than a single term of four years. Wilson held office for eleven, Hichborn for eight, and Melville for sixteen years. These three men played a most prominent part in designing the hulls and engines of the new fleet and in overseeing their construction. Melville, whose heroic achievements in the Arctic seas won for him an especial distinction, also showed capacity for extraordinary effort as Chief of the Bureau of Steam Engineering. In 1887 he personally prepared the general designs of the machinery of five of the new vessels then under construction.[155]

[155] Hamersly, Record of Living Officers of Navy, 1898, p. 301.

From 1881 to 1897 the two chiefs of the Bureau of Navigation were Commodore James G. Walker, 1881-1889, and Rear-Admiral Francis M. Ramsay, 1889-1897, each of whom held office for two terms. They exercised large powers, not only in superintending the naval personnel and directing the movements of the fleet, but also in the general administration of the navy. Even in building the new ships the energy and judgment of Walker was much relied upon by Secretary Whitney. He has been called the "ablest and most forceful man of his time in the navy."[156] During these years the influence of the Chief of the Bureau of Navigation probably reached its culmination. His rooms adjoin those of the head of the department, to whom he therefore has easy access, and whose ear he can gain and keep to the exclusion of his less fortunate colleagues. He is more frequently in conference with the Secretary than the other chiefs. He is in position to give the Secretary his naval point of view, and perhaps his prejudices and biased information. Since at this time he virtually detailed all the inferior officers of the line and had a large and often a determining influence in detailing those of command rank, he could make or break an officer by giving or refusing him an important command. Walker and Ramsay were the most unpopular officers in the naval service. They were charged with being autocratic chiefs, and with belonging to a naval clique.

In order to curb the power of the Chief of the Bureau of Navigation and abolish all grounds for suspicions of favoritism, Secretary Chandler in October, 1884, vested the power of assigning officers to duty in a small board of bureau chiefs. This plan seems not to have worked well. In May, 1885, Secretary Whitney restored to the Chief of the Bureau of Navigation, for the most part, the duties which Chandler had taken from him.[157]

Since 1881 the business of the naval committees in Congress has greatly grown in volume and importance, and appointments to them have come to be highly prized. They are among the chief "working committees" of Congress, and are powerful factors in determining the naval policy of the country. Their decision upon the numbers and types of vessels in the shipbuilding program of each year is usually final. Their views upon any measure which

[156] Buell, C. H. Cramp, 181.

[157] General Orders of the Navy Department, Nos. 322, 337; Army and Navy Journal, XXII, 225.

the department wishes to have enacted into law must be reckoned with, for their opposition to it will prevent its passage. Their members may acquire a considerable knowledge of naval affairs, especially if they are granted a long period of service. The chairmen of these committees often acquire an extensive knowledge of the navy. During the first years of the new navy the most expert and influential chairmen were Hilary A. Herbert and Charles A Boutwell of the House, and Eugene Hale of the Senate.

Throughout the period 1881-1897 much adverse criticism of the organization of the Navy Department, and especially of the system of naval bureaus, was made by Secretaries of the Navy, naval officers, members of Congress, and the newspapers. A part of this criticism was intelligent and a part was decidedly otherwise. Some of it was temperate and judicious, and some extravagant, partisan and rhetorical. Much of it was of a more or less general character, and was based upon an imperfect knowledge of the facts. As illustrating in considerable degree the rhetorical, partisan and extravagant criticism of the department, the following extract from President Cleveland's first message dated December 8, 1885, may be quoted:

> I deem it my duty to especially direct the attention of Congress to the close of the report of the Secretary of the Navy, in which the humiliating weakness of the present organization of his department is exhibited and the startling abuses and waste of its present methods are exposed. The conviction is forced upon us, with the certainty of mathematical demonstration, that before we proceed further in the restoration of a navy we need a thoroughly reorganized Navy Department. The fact that within seventeen years more than $75,000,000 have been spent in the construction, repair, equipment, and armament of vessels, and the further fact that instead of an effective and creditable fleet we have only the discontent and apprehension of a nation undefended by war vessels, added to the disclosures now made, do not permit us to doubt that every attempt to revive our navy has thus far, for the most part, been misdirected, and all our efforts in that direction have been little better than blind gropings and expensive, aimless follies.
>
> Unquestionably, if we are content with the maintenance of a Navy Department simply as a shabby ornament to the government, a constant watchfulness may prevent some of the scandal and abuse which have found their way into our present organization, and its incurable waste may be reduced to the minimum. But if we desire to build ships for present usefulness, instead of naval reminders of the days that are past, we must have a department organized for the work, supplied with all the talent and ingenuity our country affords, prepared to take advantage of the experience of other nations, systematized so that all effort shall unite and lead in one

direction, and fully imbued with the conviction that war vessels, though new, are useless unless they combine all that the ingenuity of man has up to this day brought forth relating to their construction.[138]

The most reliable and definite criticism of the bureau system was made by the Secretaries of the Navy and the naval committees. The principal defects in the departmental organization which they discovered may be divided into two classes: (1) those relating to the division of responsibility, and (2) those relating to the division of labor. The former class will be first considered. It was maintained that the division of responsibility or executive power in the Navy Department, and likewise in the navy-yards, was excessive. There were too many bureaus. Each of them was more or less independent of the other. Each magnified its own work, was jealous of its own powers, and was impatient of restraint. The bureaus were like so many little navy departments occupying towards the Secretary of the Navy the same relation that the several departments of the government occupy towards the President. The excessive division of authority at Washington caused a like division of powers in the navy-yards, with results especially direful. Each bureau at Washington had in each yard its own representatives, employees and equipment. It was said that in the pursuit of special ends the general ends were lost sight of. The department lacking proper correlating, coordinating or unifying organs. The only instrumentality of this sort was the Secretary of the Navy. In actual practice, often ignorant of the details and technicalities of the business of the navy, he fell far short of the needs of the department. He did not have the expert knowledge, time or inclination to correlate properly the work of the several bureaus and offices, and direct their activities as a unit.

The evils of the excessive division of responsibility were said to be especially manifest in the building, equipping and arming of ships. This work, the critics pointed out, was shared by four bureaus, Construction and Repair, Steam Engineering, Equipment, and Ordnance. Since a modern ship was a unit and did not fall into four well-defined and mutually exclusive parts, the duties of these bureaus often overlapped; they interfered and conflicted with each other. As a result the Secretary of the Navy was again and again called upon to settle disputes between con-

[138] Richardson, Messages and Papers, VIII, 351.

tending authorities. Each bureau attended carefully to its own work, but no one attended to combining their several activities into an organized, homogeneous and effective whole. Each bureau might perform its work perfectly from its own standpoint, while in the end the finished product might be a decided failure. The critics gave examples of this. For instance, after the *Omaha* had been commissioned and was ready for sea, it was discovered that, as a result of the bureaus working independently, her space had been so appropriated that coal-room had been left for no more than four days' steaming.[159]

Several remedies for the excessive division of responsibility and executive power were proposed. The most obvious one, of course was the uniting of two or more bureaus. With the zeal of an official new to his office, Secretary Whitney, in his annual report for 1885, recommended a sweeping reorganization of the Navy Department. The authorship of Whitney's recommendations, as well as of the criticism upon which they were based, has been attributed to Professor J. R. Soley. Whitney believed that the work of the department fell logically into three parts, and he proposed to divide the departmental duties among three bureaus: The bureau of "personnel," of "material and construction," and of "finance and accounts." A chief was to preside over each. The new organization would reduce the number of bureaus from eight to three. The work of each bureau was to be divided according to its subject matter. For instance, under the "bureau of material and construction" there were to be erected the divisions of "construction," "engineering," "equipment," and "ordnance." Whitney's plan consolidated responsibility, but did not greatly change the existing division of labor in the department. It was entirely too revolutionary to have any prospects of being enacted into law.[160]

Whitney was shortly moved to modify his plan by increasing the number of bureaus to five. Early in 1886 a bill embodying his later recommendations was introduced in the House. It provided for five naval bureaus: "Navigation," "ordnance," "medicine and surgery," "material, construction and repair," and "supplies and accounts." It changed the existing organization chiefly by

[159] Ann. Rept. of Sec. of N., 1885, xxvii-xli; Congressional Record, XVII, 5833.

[160] Ann. Rept. of Sec. of N., 1885, xxviii, xli.

consolidating three of the four shipbuilding bureaus. The bill was favorably reported by the House Committee on Naval Affairs. The House divided on party lines. The Republicans opposed the measure partly on its demerits, but also doubtless for the reason that its passage would seem to justify Cleveland and Whitney's severe arraignment of the Republican management of the department. Representative Charles A. Boutelle, of Maine, who led the opposition to the bill, succeeded in making out a rather strong case against it, and in preventing its reaching a vote.[101]

The recommendations of several other Secretaries of the Navy were less thoroughgoing than those of Whitney, and were confined to the shipbuilding bureaus. In his annual report for 1883 Secretary Chandler, in accordance with the views of a naval board that had considered the subject, recommended the uniting of the Bureaus of Construction and Repair and Steam Engineering. In his annual report for 1894 Secretary Herbert favored the consolidation of the several bureaus having to do with the building, arming and equipping of ships. Admiral Porter was of the opinion that a reduction in the number of the shipbuilding bureaus would be advantageous. In 1886 he said that "there should be a single Bureau of Construction, Steam Engineering, and Repair under one head." The opposition to the consolidation of the bureaus was very strong, and was sufficient to prevent favorable action upon any of the foregoing recommendations. The respective interests of the line and the staff were involved in the proposed changes. The engineers feared that the union of the Bureau of Steam Engineering with one of the other bureaus would deprive them of a representative in the Navy Department. The employees under the existing system viewed with alarm the introduction of a new system that might result in a reduction of the number of offices or in some other change adverse to their interests. The concentration of large powers in the hands of the chief of the proposed "bureau of ships" was considered dangerous. Many held that the existing number of bureaus was not excessive.[102]

Another proposed remedy for the excessive division of responsibility was the establishment within the Navy Department of a special correlating and unifying organ. A naval board, com-

[101] House Rept., 49 C. 1 S., No. 1469.

[102] Ann. Rept. of Sec. of N., 1883, p. 27; 1880, p. 67; 1894, p. 14.

posed largely or entirely of line officers, was to be vested with more or less power to direct the work of the department. For many years the creation of a board of this sort had been the line officers' favorite panacea for the ills of naval administration. Admiral Porter was especially partial to a "board of control," which was to consist of three line officers not below the grade of captain, and of one additional line officer of the grade of captain to act as secretary of the board. "Under the direction of the Secretary of the Navy, the board should have the general management of the naval service." The Secretaries of the Navy have generally been unwilling to give such an organization affirmative duties of administration and control. Secretary Whitney favored the establishment of a "board of control," consisting of five bureau chiefs and three additional naval officers, but he wished to vest in it merely advisory powers. A board of this sort would not have been an effective correlating force. The Secretaries during the period 1881-1897 were jealous of their powers, and naturally opposed any measure calculated to increase greatly the influence and control of naval officers within the department.[163]

Unable to obtain from Congress legislation affecting the consolidation of the bureaus, and unwilling to establish a special board to correlate and unify the work of the department, the Secretaries of the Navy resorted to other means to bring about the same end. In 1889 Secretary Tracy organized the Construction Board, consisting of the chiefs of the five bureaus, Construction and Repair, Steam Enginering, Equipment, Ordnance, and Yards and Docks, and gave it a general supervision over the designing, constructing and equipping of new ships. In this manner the several chiefs of the shipbuilding bureaus were brought together for consultation. The board was to agree upon the general plan of a ship before its construction was commenced. It was held responsible for all delays, and for failures in correlating the work of shipbuilding. Each bureau stood for its respective specialty, but the board stood for the ship as a whole, and was responsible for the success and efficiency of the completed vessel.[164]

After a thorough consideration of the subject Secretary Herbert on October 2, 1894, issued an order designed to still further

[163] Ann. Rept. of Sec. of N., 1885, xl; 1886, pp. 66-67; House Rept., 49 C. 1 S., No. 1469.

[164] Ann. Rept. of Sec. of N., 1889, p. 39.

correlate and unify the work of the shipbuilding bureaus. This he effected in the main by giving to the Bureau of Construction and Repair a certain pre-eminence. He made it responsible for the design, structural strength and stability of new vessels. It was to be responsible also for changes made in the construction of a ship after its design had been approved. Full and accurate knowledge of every change in the plans of the ships was concentrated in this bureau. The effect of Herbert's order was very beneficial.[185]

The second class of criticisms against the bureau system related to the division of labor, which, it was asserted, was both illogical and excessive. While the bureau system had fostered the growth of these evils, it was not wholly responsible for them. The Secretary of the Navy had permitted the bureaus to take on duties in a haphazard manner, until several or all of them were doing the same kinds of work. Often their duties were most heterogeneous, and were apparently assigned on no ascertainable principle. For the excessive division of labor at the navy-yards the bureau system was largely responsible. The Secretaries of the Navy proceeded to remedy these defects, as far as they were able, by executive orders.

Early in his administration Secretary Whitney turned his attention to the methods of the department of purchasing stores and supplies and of keeping accounts. He made some interesting discoveries respecting the division of the work of making open purchases. For the fiscal year 1885 $138,000 was "spent by the seven bureaus, each acting independently of the other, for coal bought, not in one lot, but at 166 several open purchases (this does not include coal bought by ships on foreign stations); 299 different open purchases of stationery were made by eight different bureaus; $121,315.66 was spent for lumber and hardware by six bureaus in 499 separate open purchases. Seven bureaus spent $46,000 for oils and paints in 269 separate purchases; 117 different open purchases of iron and steel were made at an expense of $41,524.48; $68,881.59 was spent for hemp and cordage in 45 different open purchases. Eight bureaus supply stationery to ships; three bureaus supply ships with lamps and lanterns. To the same ship one bureau supplies electric lights and the light for

[185] Ann. Rept. of Sec. of N., 1894, p. 15.

general illuminating purposes; another supplies electric search lights; and a third oil and light for the engine and fire rooms."[166]

Whitney also discovered that little responsibility for the care and disposition of the stores and supplies of the navy-yards existed, and that such property had accumulated far beyond the needs of the service. A remarkable hoarding of materials had taken place. Since neither the laws nor the system of naval administration offered any inducement to a bureau to sell its surplus stores or to turn them over to some other bureau that needed them, unnecessary stores of all kinds had accumulated in the navy-yards to the value of more than $20,000,000. About one-fifth of these were obsolete and useless, "only entailing expense for keepers and constant care to preserve them in condition." A navy board that investigated the subject brought to light some curious facts. It reported that "at the eight navy-yards there have accumulated altogether of augurs and bits, 46,566, of which 25,274 have been lying for several years at closed yards, where no work has or is likely to be done. Twenty-nine thousand five hundred and forty-two gross of screws are on hand, 10,896 gross lying at closed yards. There are 146,385 files in stock, 42,142 of them lying at closed yards. There are 11,813 paint brushes in stock; 2246 of these in the stores at closed yards. All of these tools are serviceable, mostly new."[167]

To assist him in obtaining information and deciding upon methods of reform, Whitney appointed several navy boards. One of these, which was presided over by Captain R. W. Meade, made an inventory of all the stores and materials at the yards. After thoroughly considering the subject, Whitney concluded to concentrate the work of making purchases and keeping accounts in one bureau, that of Provisions and Clothing. He began this reform in 1886, but it proceeded slowly. The advocates of the old system, under which each bureau at Washington and its representatives in the several navy-yards made their own purchases and kept their own accounts, were emphatic in their opposition to the new plan. Whitney had taken only the initial steps when his administration came to an end.

The perfecting of the new system and the putting of it into practical operation fell to Secretary Tracy. Its main features

[166] Ann. Rept. of Sec. of N., 1885, xxx.
[167] Ann. Rept. of Sec. of N., 1886, pp. 4-5.

were the establishment at each yard of a general storekeeper, who was charged with the purchase and custody of all the stores of the yard, and was responsible to the Bureau of Provisions and Clothing; the making of this bureau the purchasing agent for the whole navy; and the opening in this bureau of one set of accounts, both of stock and purchases, designed to show the exact condition of the naval appropriations and expenditures. The business, which formerly had been handled by seven or eight bureaus, was now to be transacted by the Bureau of Provisions and Clothing. This bureau was divided into two divisions: the "division of purchase and supplies," which was charged with the making of all naval purchases; and the "division of audit and accounts," which served as the bookkeeper of the navy. The chief of this bureau was now the Paymaster-General of the navy. The store-keepers in the navy-yards and the paymasters on board the naval ships, who acted as his agents, were members of the naval pay corps.[168] In 1892 the Bureau of Provisions and Clothing was given a name which more accurately described its new duties. It became the Bureau of Supplies and Accounts.

The new system was further developed by Secretary Herbert, who, like Whitney and Tracy, pronounced it a decided improvement over the old one. By concentrating the work of making purchases, various economies were effected. The hoarding of supplies was in large part prevented. Responsibility was increased and made more definite. The accounting and bookkeeping of the department were simplified, and became intelligible. The open purchases of the navy were greatly decreased. The new system, however, had its disadvantages. The purchasing agents at times lacked an intimate knowledge of the purchased articles. Long delays in making purchases sometimes occurred. From the point of view of the consumer of materials, the new system was more cumbersome than the old.

The reform begun by Whitney in making the Bureau of Provisions and Clothing the financial bureau of the Navy Department was continued by Tracy, who transformed the Bureau of Navigation into a bureau of personnel and the Bureau of Equipment and Recruiting into a bureau of equipment. It is recollected that the Bureau of Navigation had been created as the scientific

[168] Ann. Rept. of Sec. of N., 1892, pp. 53-56.

bureau of the department, and had therefore been given charge of the Naval Observatory, Nautical Almanac Office and Hydrographic Office. In 1865 the Office of Detail had been joined to the Bureau of Navigation, and since that time one officer had presided over both. To this bureau had fallen the duties of supplying ships with compasses, chronometers, navigating instruments and other articles of equipment. Its functions were most diverse and illogical. By an order dated June 25, 1889, Tracy rearranged the duties of the Bureaus of Navigation and Equipment and Recruiting. Under the latter were now placed the Naval Observatory and Nautical Almanac Office. A like disposition would have been made of the Hydrographic Office, but a law prevented, and Tracy had to content himself with asking Congress to repeal the law. The Bureau of Equipment and Recruiting was also given all the duties of the Bureau of Navigation relating to equipment, and the latter received all the duties of the former relating to recruiting. By the same order the Bureau of Navigation absorbed the Office of Detail. This order also specified that the Naval Academy, Naval Intelligence Office, Library of the Navy Department and Naval War Records Office should be attached to the Bureau of Navigation. Its duties were now fairly homogeneous, and it might have been appropriately named the "bureau of personnel and detail." In 1889 Tracy changed the name of the Bureau of Equipment and Recruiting to the Bureau of Equipment.[169]

A further simplification of the work of the Navy Department was effected by the concentration of some of its factories. For many years the fabrication of various articles of equipment had been conducted at the several navy-yards, but principally at the Boston and Washington yards. The chief products of the former were ropes and sails, and of the latter anchors, chains and galleys. The factories for these articles were concentrated by Secretary Whitney at the Boston yard. Here were to be made ropes, sails, anchors, chains, galleys, rigging, cordage, hammocks, canvas, awnings, tarpaulins and other articles of equipment. Under Whitney's orders the Washington yard confined its manufacturing to the making of ordnance. It ceased to perform many of the usual duties of a navy-yard, and became, as it was henceforth called, the "Naval Gun Factory."

[169] Ann. Rept. of Sec. of N., 1889, pp. 37-40.

The redistribution of duties among the bureaus and the addition of new offices relatively increased the work of the Bureaus of Navigation and Supplies and Accounts and the Office of the Secretary of the Navy. The chief increases in the personnel of the department from 1881 to 1897 were made in these three administrative divisions. The number of regular employees of the Navy Department in Washington, exclusive of the caretakers of the Navy Department building, on July 1, 1881, was 151; and on July 1, 1897, 293. Rather singularly the number of the employees in the four shipbuilding bureaus was but slightly increased. In 1893 an Assistant Chief of the Bureau of Navigation, and in 1894 an Assistant Chief of the Bureau of Supplies and Accounts was authorized. The former was to be of a rank not below that of commander, and the latter was to be chosen from the pay corps.

In 1883 the passage of the Pendleton civil service act placed the appointments of employees of the Navy Department in Washington receiving an annual salary of $720 or upwards, except twenty-one of them, under civil service rules. All merely clerical offices were put within the "classified service." Positions in this service could be filled only through the Civil Service Commission from a list of eligible applicants, whose merits had been satisfactorily tested by an appropriate examination. Under the rules prescribed in 1883 the Navy Department on the occurrence of a vacancy notified the Commission, which at once certified to the department the four applicants on the eligible list whose grades were highest; and from these the department selected one to fill the vacancy.[170] In course of time the Commission established several lists of eligibles corresponding to the classes of positions in the department. In 1894 President Cleveland placed the watchmen and messengers within the classified service, and in 1896 he classified many of the laborers. By the end of his second administration all the civilian positions of the Navy Department in Washington, with the exception of those of the Secretary of the Navy, the Assistant Secretary of the Navy, the private secretary of the Secretary, and a few laborers, were under the merit system. In 1896 Cleveland extended the civil service rules so as to include many of the employees of the navy-yards.

[170] First Ann. Rept. of Civil Serv. Comm., 24, 45-51, 68.

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DETERMINATION BY RADIO-TELEGRAPHY OF THE DIFFERENCE OF LONGITUDE BETWEEN PARIS AND BIZERTE.

By MM. LANCELIN and TSATSOPOULOS, under the direction of M. H. RENAN.

Translated by Ensign B. S. BULLARD, U. S. Navy.

FIRST PART.

DESCRIPTION AND INSTALLATION OF THE INSTRUMENTS AND OF THE APPARATUS.

By M. HENRI RENAN.

EDITOR'S NOTE.—This translation and publication have been made with full consent of all parties concerned, and the article should be of particular interest to the service, because the method here described is entirely similar to that used in the recent determination of longitude between Washington and Paris. This determination of longitude is to be repeated under a longer time interval this coming winter.

INTRODUCTION.

In the second half of the 17th century, in 1671, Picard, wishing to measure the difference of longitude between Copenhagen and Uranibourg, made use of a light kindled on the tower of Copenhagen, which could be suddenly made to appear. It appears that this was the first time that anyone made use of the method of instantaneous signals which could be seen simultaneously in the two stations which were to be referred to one another. In the course of the 18th century use was also made of bombs, fuses and of simple powder fires, but it was not until the middle of the 19th century that the introduction of the electric telegraph permitted anyone to obtain a precise solution of this important problem.

In 1844 experiments were made in America by Wilkes and Eld, to measure the difference of longitude between Washington and

Baltimore by electric signals, but these first experiments did nothing more than furnish proof of the reliability of this method. It was not until 1846 that we find a reliable determination made by Walker and Gilliss between Philadelphia and Washington.

The method thus inaugurated in the United States during this epoch has become the one in absolute general use. Within a few years the method had arrived at such a state of perfection that, considering the accuracy of the instruments for the measurement of time, it was difficult to admit that the precision then obtained would be surpassed.

To measure a difference of longitude two distinct operations are necessary. In the first place, it is necessary to know the sidereal time or the mean time at each of two stations from which we determine the correction, and the rate of two clocks placed, respectively, in each station. It is necessary therefore to compare these two clocks with one another at some predetermined instant.

In that which relates to the first part, it appears that the determination of the time cannot be made with a precision much greater than that which we obtain by observation of the transits of stars across the meridian. On account of this fact we have made use of small portable meridian telescopes which are installed in each station. The original method of observing by the eye and ear has been almost universally superseded, for about a half century, by the recording chronograph. Unfortunately in discussing the results of observations thus obtained we quickly discover that differences in the personal equation of observers are sensibly modified by a change of method, but are not completely eliminated.

The personal equations hardly appear to diminish and we can see that the new procedure will introduce a variableness of the equation of an observer—unequalness which does not appear to have existed heretofore.

In order to make this source of error disappear in the definite results, we exchange the observers and it is clear that then the success of the method depends upon the constancy of the personal equation. We hope to decrease the chance of error by the exchange, at the same time keeping as far as possible the same conditions for two experienced persons.

The greatest progress realized under this idea was the invention of the micrometer recorder of Repsold. By the use of this apparatus, at the present time universally used, the values of the differ-

ences of personal equations have become so small that they can be considered completely negligible. However, for prudence' sake, we have continued, in every determination of longitude, to exchange observers. Because of the extreme minuteness of the personal equation we assume that it does not vary and consequently we are almost correct in assuming that this last precaution frees the result of all errors of this nature.

The first application of the micrometer of Repsold was due to the initiative of the Geodetic Institute of Prussia, and the first determination in which it was employed was made in 1891 between Berlin and Potsdam. Simultaneously a very lucky modification was made by the astronomers during the observation. The telescope was reversed between the two parts of the observation of each star, eliminating immediately the errors of the collimation and reducing those due to irregularities of the micrometer screw and of the trunnions. From this we see that considerable advantage was gained by the new method.

Since that period a great many measurements have been made in Germany on the principle that we have indicated, and the precision of results obtained on different evenings shows a very remarkable agreement.

We know that in Repsold's micrometer, as it was made by the ingenious inventor of Hamburg, both hands of the observer are used to give the movement to the micrometer screw so that the movable wire will follow the star in the field of the telescope. To facilitate the task of the astronomer we might wish to put at his disposal a controllable force. To accomplish this, in France, our lamented P. Gautier succeeded in constructing a simple practical apparatus of easy management which functioned satisfactorily for every condition of any complicated problem. The first self-recording micrometer of Gautier was installed with the meridian circle in the garden of the Paris observatory, towards the last of the year 1906. When it was put in use it was very quickly realized to be an important factor toward the measurement of the times of transit.

In 1909 the Bureau of Longitudes gave a new activity to the Paris observatory by ordering two small portable meridian telescopes from the firm of Gautier, which could be very rapidly reversed and which were provided with recording micrometers and motors. The illness of the eminent artist and his unexpected death

retarded somewhat the construction of these instruments. They were completed, however, by M. Prin, Gautier's successor, in the first part of the following year, and since then have been at our disposal. The greater part of the year 1910 and the first two months of 1911 were devoted to the study of the instruments, and the month of March, 1911, saw the beginning of the determination which is here recorded.

Considering now the second part of the problem, that is, the comparison of the clocks, as we have said above, for a long time we have been able to use telegraphic signals. Following a period of more or less successful experiments, the problem appears as follows: The observations of stars which give the time in each station must be simultaneously recorded on two chronographs placed one in each place of observation.

It is very evident that if we wish to determine a result with great precision the chronographic marks, proceeding from the exchange of signals, should give comparisons of the observations of the stars and the relative positions of these marks are identically the same as those recorded by the same clock. On account of this very minute precautions are made possible by different apparatus; rheostats, relays, milliammeters, switches, etc., being placed, together with the chronograph, on a table.

In 1873, during the determination of longitude made by Oppolzer and Lœwy, between Paris and Vienna, Lœwy constructed a chronographic table[1] which, save for a few successive perfections, can be regarded as the type used from that day to this. In 1874[2] for the longitudes of Paris-Marseilles-Algiers the first table was modified by its author. In 1877 for the longitudes of Paris-Berlin and Paris-Bonn[3] it was submitted to several small changes and from this time it took a definite form, which was adopted in France, and was used for the measurement made in 1902 between Paris and Greenwich. The table of Lœwy is very complicated, but, however, if we obtain a good regulation at the beginning of operations, it is a very simple method and theoretically it satisfies all the conditions of the problem.

[1] Annales de l'Observatoire de Paris: Observations, 1874.
[2] Mémorial du Dépôt général de la Guerre, t. XI.
[3] Annales du Bureau des Longitudes, t. II.

In England, in the beginning of 1892,[4] the Greenwich astronomers adopted a simpler arrangement. The employment of their chronographic table abolishes certain operations which are necessary with the table of Lœwy and which the latter has designated as pen parallax. However, the principle of the method has remained the same and the solution of the problem is still theoretically perfect. However, in the English chronograph the marks of observations and the marks made by the clock are sometimes confounded.

This last inconvenience does not exist in the apparatus used by the Geodetic Institute of Prussia. Although the chronographs used have two pens, as the English, they are made so that the palettes which carry the recording pens are put in motion by the same current which, as one can easily see, abolishes the measure of the parallax of the pens.

The first apparatus thus constructed dates from 1874[5]; the most recent installation is one of perfect simplicity and one of extreme practical management. It was tested for the first time in 1901 during the determination of the longitude between Potsdam and Bucharest. It was used again in 1903 for that of Potsdam-Greenwich,[6] and since that period it has not ceased to give entire satisfaction to the German astronomers.

This was the state of the problem when the invention of radiotelegraphy opened a new field. It was very evident from the first that for the exchange of signals between the two points this marvelous discovery would be a veritable source of progress. The first researches on this subject were due to the initiative of M. Albrecht, who, with the help of M. Wanach, made a series of experiments in the autumn of 1904 to determine the precision which could be obtained by the use of coherers.

The results of this work were published in No. 3982 of *Astronomische Nachrichten*. They showed that not more than 0.008 second was required to put them in operation, and that consequently they were instruments of the same precision as those which were used for the ordinary telegraphic measurements.

[4] Royal Observatory, Greenwich. Determinations of Longitudes, 1888-1902.

[5] Formeln und Hilfstafeln für geographische Ortsbestimmungen, von Th. Albrecht, 3d edition, Leipsig, 1894, p. 105.

[6] Veröffentlichung des Königl. Preuszischen Geodätischen Institutes, Neue Folge, no. 15, p. 34.

Less than two years afterward, during the summer of 1906, the astronomers of Potsdam, wishing to further experiment, undertook to compare the exchange of signals by radio-telegraphy with that by the ordinary telegraph during the measurement of the difference of longitude between their observatory and the station in Brocken.[7]

The Hertzian waves were sent out by the station at Nauen, situated at 32 kilometers from Potsdam and at 183 kilometers from Brocken. The signals were given by the oscillation of a pendulum at equal intervals of 2.4 seconds. By means of antennas and receiving sets placed in the two stations, they were recorded on the two chronographs so well that each signal immediately gave the difference of the clocks. The chronographic table used for the record of the signals was the same as that described above and care was taken to interpose the radio-telegraphic signals between those of the ordinary telegraph.

By this method they obtained in each evening's observation two distinct values for the difference of the clocks.[8] These two values were attributed to small errors of observation and they never surpassed 0.006 or 0.007 second.

In our determination of the difference of longitude between Paris and Bizerte we had in view the application of the radio-telegraph to measurement over a great distance. The methods used were necessarily completely different from those given above. Our two stations were 1550 kilometers apart and the intensity of the waves at reception was not great enough to record the signals by means of the coherer, and we therefore had recourse to the use of telephones, which was the only method applicable in our case.

In 1906, during a measurement of longitude made between Brest and the observatory of Montsouris, MM. Claude and Driencourt made use of a direct method of telephonic comparison of the chronometers in the two stations. To obtain a great precision they conceived an ingenious idea of combining a sidereal time chronometer with a mean time chronometer, so that the comparison

[7] Ibid., no. 31, p. 40.

[8] In reality the radio-telegraphic signals were of three different kinds. Some were sent out with a chosen standard power, some with one-half power and some with one-quarter power. No difference in the results was found by the use of three powers of sending.

could be made by the method of coincidences. Everyone knows the great precision which can be obtained by this procedure when it is used by experienced observers.

In the beginning of the year 1909, in view of utilizing Hertzian waves for the determination of longitudes, MM. Claude, Driencourt and Ferrié installed in the Eiffel Tower station an arrangement which was proposed by M. Claude. In principle, their method consisted in a telephonic comparison of the coincidence of the sound produced by each of the clocks at the beginning of its second and the sound proceeding from the emission of the waves. In an arrangement of this kind, where the interval between two radio-telegraphic sounds was a little longer than a sidereal second, the coincidence of the two sounds came at regularly determined intervals, and were perceivable in the receiver of a telephone and could be noted by the observer.

In the month of January, 1910, and several times afterwards, experiments were made to test out and regulate this installation, between the observatories of Paris and of Montsouris and the Eiffel Tower station. In March, 1911, M. Driencourt, at Bizerte, and M. Claude, at Paris, made use of their apparatus for the first time.[9]

The action of the Hertzian waves over as great a distance as that which separates Bizerte and Paris would not have been perceptible except for the very large power of the Eiffel Tower sending set. As it was intended to find out if the time necessary for the waves to travel this distance was appreciable to the accuracy of the time-measuring instruments, it was necessary to send out signals of the same kind from Bizerte. The sending station of the arsenal of Sidi-Abdallah was made use of, and the looked-for result was obtained by installing a powerful aerial at the Paris observatory.

From the instant that we stopped recording the signals directly by the chronographs all the complications of the chronographic table which was used before became useless. However, as we will show in the course of this paper, it was necessary to take certain precautions which allowed us to refer the corrections which we deduced from the record of our observations of stars to the clock

[9] See Comptes rendus de l'Académie des Sciences, 1er mai 1911, and the report of MM. Claude, Driencourt and Ferrié, Annales du Bureau des Longitudes, t. IX.

which was used for the telephonic comparisons. To do this we built for each station a very simple chronographical table which will be described later, and which satisfies all the theoretical conditions of the problem, being extremely easy to use and giving no trouble during the duration of the problem.

In synopsis, in this determination, we have, for the measurement of the hour of sidereal time, made use of all the improved methods, using the auto-recording micrometer with motor attachment, chronographical recording of the transits, reversal of the telescope between the two parts of the observation of each star, with levelling of the instrument repeated after each reversal.

For the comparison of the clocks, we made use of the installation which was installed at the Eiffel Tower by MM. Claude, Driencourt and Ferrié, always making use of the method of coincidences. The radio-telegraphic sparks were produced at intervals of very nearly one sidereal second. The observers did not have to note the instant when the sound of their chronograph and that of the spark coincided in the telephone receivers. We will say here that by means of several necessary precautions the coincidences at Paris and at Sidi-Abdallah were referred to certain datum points which were determined beforehand and which were the same for both places.

The officers of the geodetic service of the army made the measurement of the difference of longitude between Bizerte and Paris at the same time that the astronomers of the observatory made theirs. They worked constantly with the same clocks and the same antennas, and for the measurement of the sidereal hour they made use of an astrolabe prism. Their Paris station was installed in the garden of the observatory at a very short distance from our meridian instrument; the station at Bizerte was, like ours, in the arsenal of Sidi-Abdallah, while the receiving apparatus for the radio-telegraphic waves was the same for both sets of observations, each one making use of it in turn.[10]

In this paper we have shown only the part of the work done ourselves, with the results. We can, however, remark that the two final results agreed in a remarkable manner, notwithstanding the differences between the processes of observation.

[10] See Comptes rendus de l'Académie des Sciences, 22 January, 1912.

CHAPTER I.

INSTRUMENTS FOR THE MEASUREMENT OF TIME.

1. *Portable Meridian Telescope.*—A pillar made of freestone, having the form of a rectangular parallelopiped, supports the telescope. One of the edges of the upper surface is parallel to the meridian and is 0.7 meter in length; the other edge, which is perpendicular to the meridian, is 1.1 meters long, and the height of the pillar above the floor of the observation room is 0.7 meter. The foot of the instrument is supported by three adjusting screws, which are placed at the corners of an isosceles triangle. The base of this triangle is 0.46 meter long and is parallel to the meridian, being placed 0.19 meter from the east side of the pillar. The height of the triangle is 0.72 meter and is perpendicular to the meridian, its apex being consequently close to the west edge. Each of the screws rests upon bronze supports which are firmly fixed on the pillar. The one on the west side has a small round hole in its center, into which the extreme end of the corresponding screw fits. The two supports toward the east are different. The one toward the south is perfectly smooth; the other has a horizontal groove which engages the regulating screw of the instrument and which can be moved by means of a screw in a direction perpendicular to the meridian.

A solid stand of bronze, which is carried by the three adjusting screws, constitutes the base of the instrument proper. Two vertical uprights, situated on the stand at a distance of 0.6 meter apart, carry the bearings. A lever resting on the pedestal forms the apparatus for reversal and allows two movable uprights to be raised. This operation of reversal can be made very rapidly, taking hardly a tenth of a second.

By a convenient regulation of the height of the two eastern screws the two uprights, which carry the bearings, can be made vertical. This being done, the axis of the trunnions can be made horizontal by means of the western screw. Lastly, the azimuth of the instrument is regulated by moving the groove in the northeast support. The stability of the instrument is assured by set screws which block the three adjusting screws and the screw of the horizontal groove.

The eye-piece of the telescope is 0.075 meter in diameter and has a focal length of 0.84 meter. The two trunnions are hollow

to allow the rays of light to enter which illuminate the field. Two small electric lamps to supply this light are placed at the height of the trunnions, one on either side of the instrument, and a small prism fixed in the central cube of the telescope sends this light to the eye-piece. The position of the telescope regulates the direction from which this light comes. In one position it comes from the east trunnion and in another from the west trunnion.

A cat's eye, which is moved by a button placed on the outside surface of the central cube, regulates the intensity of this light. As the movement will be small during the greater part of the observation, we have introduced a small rheostat in the lamp circuit, whose resistance is varied by a slider which can be moved by hand. This rheostat is placed on top of the pillar and is always within reach of the observer, who, at the instant of transit of a star, can, without great trouble, obtain the necessary amount of light.

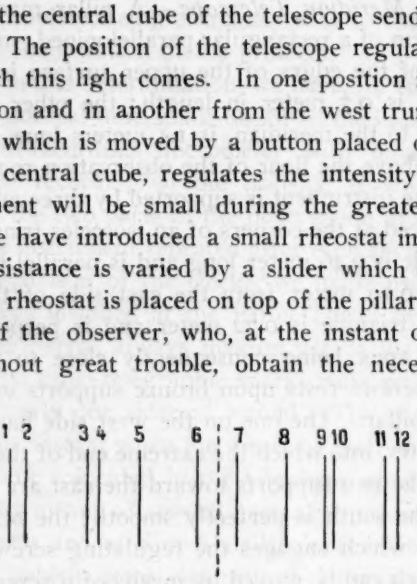


FIG. 1.

The observations are made by means of an ocular elbow. The net-work of wires is composed of one horizontal wire which occupies the middle of the field and twelve fixed vertical wires. The wires 1 and 2, 3 and 4, 9 and 10, 11 and 12, form four couples of which the component wires are very close together. The equatorial distance of the important wires from the ideal wire are:

Wire	1	41 secs.
"	4	25 secs.
"	5	16 secs.
"	6	4 secs.
"	7	4 secs.
"	8	16 secs.
"	9	25 secs.
"	12	41 secs.

We will see later how this arrangement has been put in use. The displacement of a movable wire is obtained by means of a micrometer screw of which one turn approximates to 7.9 seconds on the equator.

A level which can be placed on the upper part of the trunnions allows us to measure the inclination of the axis. The vial is divided into 100 equal parts and its curvature is such that the value of one part does not exceed 0.05 second.

Finally, a small copper circle fixed on one of the trunnions allows us to measure the elevation of the telescope. Around its outer edge is a gold band 0.23 meter in diameter which is divided into main divisions of 10′. Light is furnished by that of the field and the readings are made by means of two reading glasses placed on the vertical mounts of the foot.

2. *Recording Micrometer with Motor.*—In general, the installation of this part of the instrument is the same as that made with the meridian circle of the garden.[11] However, due to the difference in size of the two instruments, it was found necessary to make several modifications of which we will give a brief description.

On top of the pillar and to the west of the instrument the motor and the differential apparatus are placed. The motor is very small, its greatest dimension being 0.12 meter. It is of the direct-current type and is run by a storage battery of 12 volts. Under this voltage it makes about 110 revolutions a minute without vibration and consequently causes no vibration or derangement of the foot of the telescope. Its rotation is communicated to two parallel disks which turn in opposite directions and whose distance apart can be varied by means of a system of levers and springs. When they are as close together as possible they rest upon the edge of a horizontal platform which follows the pressure put upon it and turns around its vertical axis. When the two disks are as far apart as possible, the platform can be displaced in height on its axis, so that, depending upon the position its edge takes upon the disks, the speed will be varied. A small vertical stem fixed in front of the platform between the two disks and divided into millimeters allows us to read the height to which it is placed.

The vertical axis of the platform is terminated at its upper end by a gear wheel which engages a pinion whose axis carries another wheel situated a little above it. In the same plane with this wheel and engaging with it is another, identical to the first, which carries

[11] See on this subject the paper appearing in Tome XXVI of the Annales de l'Observatoire de Paris (Mémoires) and entitled Le nouveau micromètre enregistreur du Cercle méridien du Jardin de l'Observatoire de Paris.

a pinion situated at the same height as the first, except that this second pinion does not touch the gear wheel which is on the end of the axis of the platform. This results in the platform, when it is driven by the vertical disks, turning the pinions of which we have spoken in opposite directions.

In the horizontal plane of these two pinions there is a gear-wheel of greater diameter, whose axis, on account of its importance, will be called the principal axis. In the ordinary position neither of the pinions touches the large wheel, but their axes are fixed on a piece which can be turned by means of an eccentric. In turning this piece in one direction the right pinion engages with the large wheel while rotation in the other direction causes the other pinion to engage. It is easy to see that in the ordinary position, while the two pinions turn, the large wheel does not, but a movement of the eccentric produces a rotation in one direction or the other. A polished button placed above the eccentric moves this small piece.

The surface of this large wheel is pierced by a vertical axis, which is provided with a pinion at each end. When they turn they do not actuate the principal axis, but only this secondary axis, which describes a cylinder around the principal axis. The upper pinion of the secondary axis engages a tooth wheel, which is made fast to a loose collar around the principal axis, and which turns independently of it. The lower pinion engages with another toothed wheel which is solidly fixed on the principal axis.

If the upper collar is fixed it is easy to see that the upper pinion will turn and consequently the lower pinion of the secondary axis will turn the principal axis. The toothed wheel of the upper collar engages with an angle wheel which can be rotated by a horizontal spindle. This spindle is terminated at its north and south ends by two polished buttons, which are placed close to the hand of the observer. In moving this spindle in one direction we accelerate the rotation of the secondary axis and consequently that of the principal axis. In moving it in the other direction we retard the rotation.

This differential apparatus is exactly like that which we have described in the paper quoted above, and permits us to accelerate or retard the rotation of the principal axis without changing the speed of the motor.

The principal axis is prolonged by a spindle on which is secured at its upper end a system of gear wheels which engage with

a toothed ring on the western trunnion of the telescope. A spindle is fixed to this ring and penetrates to the central cube of the telescope, where its motion is transmitted to the axis of the micrometer screw.

On this axis, and turning with it, is a wheel on the circumference of which are eight metallic points. These points pass successively under a small spring which they raise completing an electric circuit through the coils of the chronograph. We have therefore eight contacts for every revolution; that is to say, about one signal of the chronograph a second for an equatorial star. A small interrupter placed on the telescope close to the eye-piece allows this circuit to be opened or closed at will.

In order to distinguish the contacts from one another at a certain point of the wheel corresponding to the zero point of the circumference we have inserted a supplementary point, which is not used under general conditions.

By a transmission system, whose details are not interesting, the plate which carries the ocular automatically moves so that the movable wire is kept in the middle of the field during the observation. It is easy to see that this eliminates visual parallax and greatly diminishes the personal equation.

Finally, to avoid accidents which could be produced by the wheel still revolving when the micrometer screw and the ocular have reached the limit of travel, it is not firmly attached to the axis of the micrometer screw, but drives it by friction. The movable wire can also be moved by hand at the will of the observer when the motor is not running.

3. *Clock, Chronographic Table and Chronograph.*—At the Paris Observatory a sidereal clock, synchronizing with our directing clock and a similar clock, with an independent rate, were used in our determination. Each of these clocks was supplied with a Bréguet interrupter, which closed an electric circuit at each oscillation of the pendulum, first to the right and then to the left, and consequently once each second. The two parts of the interrupter were isolated from one another and each was inserted in a separate circuit, so that we could use the even or the uneven numbered seconds. As the officers of the geographical service of the army made their observation at the same time that we did and used the same clocks it was convenient for one to use the right interrupter and the other the left.

The chronograph used was one of Hipp's. Uniformity of movement is obtained by means of a vibrating blade and a band of paper which unrolls itself in accordance with this movement. A support carries two small siphons instead of pens, which rest lightly on the paper and which draw their ink from the reservoirs to which they are soldered. These pens are fixed to the ends of two levers, which can move in a horizontal direction and which have malleable palettes at their other ends. These palettes form the armatures of two coils, *C* and *D*, in the figure, which, when an electric current flows in one of them, attracts its palette and the pen corresponding makes a mark on the band of paper.

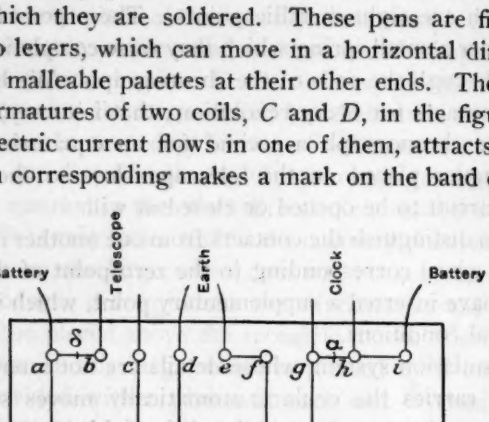


FIG. 2.

The chronographic table which has been constructed is extremely simple. It is built in the form of a rectangle, 0.80 meter long and 0.60 meter wide, and holds the chronograph and a system of electrical connections which will be described in detail.

On the end of the table are nine binding posts, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h* and *i*, and copper strips lead the current from them, as can be seen from the figure. Figure 2.

To *a* the leading wire from the positive pole of a battery is made fast; to *b* is the wire leading to the micrometer of the telescope; to *c* is the wire returning from the telescope, and to *d* is the wire returning to the negative pole of the battery. In ad-

dition the wires leading to the telescope may be short-circuited and the circuit closed by touching the ivory button of a switch which is introduced in the circuit.

In the same manner, to *i* the wire from the positive pole of a battery is made fast; to *h* and *g* are the wires leading to the interrupter of the clock, and to *e* is the wire returning to the negative pole of the battery.

The binding posts *k* and *l* are for the coil *c* and the binding posts *m* and *n* are for the coil *D* of the chronograph.

Considering now the clock circuit: Every two seconds it is closed by the interrupter and the current following the circuit *i, h, g, k, l, f, e* flows around the coil *C* of the chronograph, causing the pen to trace a line. This continues throughout the duration of the observation.

At the instant when the recording micrometer of the telescope closes the other circuit, the current following the path *a, b, c. m, n, d* flows around the coil *D* and the other pen traces a line. The same result is obtained by pushing the ivory button of the short-circuiting switch.

In view of a necessary determination, which will be seen later, we have introduced a slight complication. From the binding post *a*, a copper strip leads to a binding post at *o* and from *m* another strip leads to a binding post at *p*. From *o* a flexible wire leads to the end of the coil *C*, and from *p* a wire is led to a point which touches the palette of *C* at the end of its travel. This auxiliary circuit is insulated in such a manner that it is closed at the instant that the pen, actuated by the clock, reaches the end of its travel.

At γ and δ are placed two switches. If γ is open and δ closed everything acts as we have explained above. The auxiliary circuit cannot close by the action of the micrometer or by the switch. However, if δ is open and γ closed, at the instant when the pen actuated by the clock traces its line, the circuit is closed and the current following the path *a, r, o, p, s, m, n, d* flows around the coil *D* and the second pen traces a line.

Finally, α and β are two other switches. If α is open and β closed everything takes place as explained at first above, and the pen of the clock marks every other second, but if we close α we will have a continuous current in the coil *C*. The same result can be obtained for the coil *D* by keeping the switch in the micrometer circuit closed. This is made use of in measuring the resistance, intensity of current, etc.

4. *The Recording of Observations and Choice of Observed Stars.*—Our method of observation is founded upon two principles: first, automatically recording the instant when the movable wire, which is constantly maintained in coincidence with the star, passes certain fixed positions; second, reversal of the telescope between the two parts of the observation. It is also necessary to have the positions which are recorded in the second part identically like those recorded in the first.

If we are dealing with an hourly star, we record transits during the time that the star passes from wire 1 (Fig. 1) to wire 4. Then reversing the instrument, we record the transits during the time that the star passes back from wire 4 to wire 1.

Calling t_1 the clock time of transit recorded in the first part of the observation; c the collimation of the wire at the same instant; a_1 and β_1 the azimuth, and the inclination of the telescope in the first position; C_p the correction of the clock; A and δ the coordinates of the star; ϕ the latitude and κ the coefficient of diurnal aberration, we have

$$(A'-t_1-C_p)\cos\delta=\beta_1\cos(\phi-\delta)+a_1\sin(\phi-\delta)+c-\kappa. \qquad (1)$$

Putting the subscript 2 to the quantities which change in the second part of the observation

$$(A-t_2-C_p)\cos\delta=\beta_2\cos(\phi-\delta)+a_2\sin(\phi-\delta)-c-\kappa. \qquad (2)$$

Combining 1 and 2

$$\left(A-\frac{t_1+t_2}{2}-C_p\right)\cos\delta=\frac{\beta_1+\beta_2}{2}\cos(\phi-\delta)+\frac{a_1+a_2}{2}\sin(\phi-\delta)-\kappa.$$

It is easy to see from this equation that to determine the correction C_p we must know $\frac{\beta_1+\beta_2}{2}$, that is, the half sum of the inclinations of the telescope in the two positions.

When the telescope was in the first position we suppose, for example, that the level was placed on the trunnions in such a way that the bubble was toward the west, and that the sum of the readings of the extremities of the bubble is s_1; then after reversal, when the bubble moves in the opposite direction, that the sum of the readings is s_2. It is obvious that $\frac{\beta_1+\beta_2}{2}=\frac{s_1-s_2}{4}$ and is entirely independent of any error due to irregularities in the trunnions.

For the observation it is necessary to know at what height the

horizontal platform between the two vertical disks should be placed in order that the speed of the movable wire will be equal to the speed of a star in the field of the telescope. To accomplish this, if x represents the division of the spindle which indicates the height of the platform, we have

$$x = a - b \cos \delta,$$

in which a and b are two constants which must be determined.

Also, if t is the time that the star takes to travel a distance corresponding to one turn of the micrometer screw and calling k the equatorial value of this turn, we have

$$t = k \sec \delta.$$

From which

$$x = a - \frac{bk}{t}$$

By placing the platform successively at the divisions $x_1, x_2, \ldots . x_n$ of the spindle and observing the time that the micrometer screw makes 10 turns in each of the positions, we will have the values of $10t_1, 10t_2, \ldots . , 10t_n$. From these values we obtain n equations with two unknowns a and b. We solve them by the method of Cauchy which is nothing more than making out a table which gives values of x for corresponding values of δ.

As we have nearly always taken hourly stars close to the zenith we will suppose that the declination is 40° and explain the procedure of the observation.

First, it is necessary to put the interrupters or switches of the chronographic table in the ordinary position, that is, open γ and α and close β and δ.

Four minutes before the transit of the star we place the level on the trunnions and then wait two minutes for the bubble to come to rest. During this time we place the platform at the height which is taken from the table described above.

The reading of the level is now taken, the level lifted off and the telescope clamped in declination, these operations requiring about 30 seconds.

The eye is then put to the eye-piece, the focus rectified, the light regulated, the movable wire brought on the star and put in motion by means of the polished button on top of the differential.

Assuming that this takes 35 seconds, 55 seconds will still remain before the transit across the meridian and the star will have almost

reached wire 1. The contact for the chronograph is now made with the hand which is not occupied with the differential. The recording is stopped at the instant when the star reaches wire 4, which is 21 seconds after its passage across wire 1; 33 seconds will therefore remain before the transit across the meridian.

The telescope is then brought to a vertical position, reversed and reclamped. The eye is then placed to the eye-piece, the focus rectified and the movable wire brought back of the star. The motor is put in operation and the differential used. One has one minute and six seconds to accomplish this.

At the instant that the star crosses wire 9[12] the contact is made and the recording commences. It is stopped 21 seconds later, when the star reaches wire 12.

If the star is setting, we bring back the movable wire to the left of wire 1, but if we are using a circumpolar star we bring it back only to the left of wire 5 if it is an upper transit, and to the right of wire 8 if it is a lower transit. The observer then places his hand on the switch and on an even second of the clock gives a time signal to the chronograph.

If these last operations take 20 seconds, the complete observation of a star takes 5 minutes and 15 seconds. As the declination of the star decreases, the time necessary will be different, but in all cases the observation can be made as described above. If the declination is 60° the period of the complete observation will not exceed 6 minutes and 15 seconds.

As it is easy to see from the equations given above, if the azimuth of the telescope is not the same in the two positions it will be the half sum, $\frac{a_1+a_2}{2}$ that will be used in the calculation of the instrument correction. We are led to observe our circumpolar stars in the same manner, but it is necessary that the apparent motion of the stars will not be sluggish or otherwise the observation will cover a very long period of time.

To obviate this we have chosen stars whose declination lies between 81° 45′ and 84° 30′. The secants of their declination vary from 7.0 to 10.5, and if the same part of the field is used for these

[12] We might remark that, according to the position of the telescope, we have always used the numbers 1-6 for the wire to the left in the ocular elbow, the observer being to the south, and the numbers 7-12 for the wires to the right.

stars the observation will be too long. To shorten the duration of the observation we use the wires 5, 6, 7 and 8. The procedure of the observation is identically the same as that described above, except that the records are made between wires 5 and 6 and 7 and 8 with the reversal of the telescope during the interval when the star is passing from wire 6 to wire 7. For the star whose secant is 10.5 the observation will take almost 9 minutes.

The choice of circumpolars, however, results in an uncertain determination of the azimuth of the telescope, and it is because of this that we have been forced to choose stars which are not close to the zenith, but are situated as far as possible to the north and to the south of it. Taking this precaution, we can eliminate almost completely any error due to the azimuth in the definite results.

We have taken the mean places of our stars from the preliminary catalogue of 6188 stars of M. Lewis Boss, but the precision of the chosen positions is not of extreme importance, because we have taken care to observe the same stars in each of the two stations.

5. *Calculation of the Instrument Correction.*—After the preceding explanation, it is easy to see that six contacts have been in general recorded for each part of the observation of an hourly star, and that these two series of contacts will correspond to the same positions of the micrometer screw. It is necessary to throw out the first two or three of each series, because at the instant that we commence to follow the star by means of the differential there will always be a certain period of hesitation and uncertainty. In general, we have only used the ten contacts in the middle of each series and consider their position by comparing them with the supplementary contact of which we have already spoken. We have lengthened these contacts almost 0.01 second on the band of the chronograph.

If we designate by t the mean of the numbers thus obtained by β, the half sum, $\frac{\beta_1+\beta_2}{2}$ of the inclinations and by α the azimuth of the telescope, we will have

$$A=t+C_p+M\alpha+N\beta-\kappa \sec \delta,$$

putting

$$M=\frac{\sin(\phi-\delta)}{\cos\delta} \text{ and } N=\frac{\cos(\phi-\delta)}{\cos\delta}.$$

This presupposes that the collimation of the movable wire is constant at the instant of the two readings and is not always exactly true in our procedure of observation. It is clear that in the first part of the observation the record is made by one edge of the points of the contact wheel touching the spring and that in the second part it will be the other edge of the points which touches the spring and causes the record of the contact. To correct this small error of collimation we bring the observation back to what it would have been if it had been made at the middle of the contact point. Therefore, if we call E the half thickness of the contact points expressed in time it will be necessary to add $E \sec \delta$ to the expression above.

We will indicate in the second part of this paper how the value of E can be found.

It is therefore necessary to write

$$(1) \qquad A = t + C_p + M\alpha + N\beta + (E - \kappa) \sec \delta.$$

We proceed in the same manner for circumpolar stars, except that in general we only record twelve contacts and consequently it is not necessary to reject any at the beginning and at the end of each series. This will be sufficient because of the longer interval that elapses between two consecutive contacts.

In case of a lower transit the correction for collimation and diurnal aberration will be $(E + \kappa) \sec \delta$.

In every case we have taken care to place the level in one way for one position of the telescope and in the opposite way for the other position, so that in combining two consecutive readings we have the value of β. In general, we consider the inclination as constant during a certain interval of time and we take for β the mean of the values corresponding to this interval. We also know $(E - \kappa)$ and from these we can calculate the value of the corrective terms $N\beta$ and $(E - \kappa) \sec \delta$.

Let

$$A - t - N\beta - (E - \kappa) \sec \delta = U.$$

The equation for each star will then be

$$U = C_p + M\alpha.$$

If we compare an hourly star to a circumpolar we will have for the circumpolar

$$U = C_p + Ma,$$

and for the hourly star

$$U' = C_p + M'a;$$

from which

$$a = \frac{U - U'}{M - M'}$$

In every case we have taken two hourly stars. We have calculated the quantities U' and M' for each of them and it is the mean of these calculated values which we have used in the equation for a.

6. *Determination of the Correction of the Clock.*—Considering the formula marked (1) we now have all the necessary factors to calculate the value of C_p for each star. However, in this formula t is expressed in clock time and it is therefore absolutely necessary to define the origin taken for the second of this clock, so that it will be the same for the calculation of t and for the radio-telegraphic comparisons which have to be made.

If the clock has a regular rate the beginning of contact of the interrupter will be at definite intervals of very nearly 2 seconds duration. This series of contacts can be used as the origin of the second.

The electric current will transmit itself instantaneously in the circuit of the clock and it consequently reaches the coil C of the chronograph at the same instant that the circuit is completed in the clock. But between this instant and the instant that the palette of the pen begins its movement, a period of time, which we can call ϵ_1, will elapse and this interval will be due to the time taken for the armature of the electro-magnet to complete its movement. If this period ϵ_1 is constant during the entire observation we can also use this instant for the origin of the second.

Lastly, if ϵ_1 is constant, the palette will always take the same time to complete its movement and the time elapsing between the instant that it commences its movement and the instant when it strikes the coil of the electro-magnet will be constant. Therefore the time elapsing between the sounds coming from two consecutive shocks can be taken as the origin of the second.

In résumé, we can thus make use of three different clocks. In the first the origin of the second will be the instant that the

circuit is completed by the interrupter of the clock. In the second the origin will be the instant at which the palette begins its movement and a time ϵ_1 will elapse between the first origin and the second. Finally, in the third clock the origin will be the instant that the palette strikes the electro-magnet and we will call ϵ_1' the time elapsing between the second origin and the third.

The first clock will not mark each indication on the chronograph. For the second the origin will be marked by the beginning of the notch traced by the pen, that is to say, by the point A in figure 3. Then obviously the point B will correspond to the origin of the second of the third clock and the quantity ϵ_1' will be the distance AB' expressed in time.

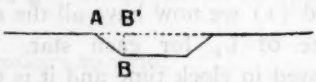


FIG. 3.

Let us pass now to the recording of the observations. At the instant that a contact is made in the telescope it is a certain known sidereal time which we will call θ. But from the instant at which a contact is made, and the instant at which the corresponding palette begins to move, a certain period which we will call ϵ_2 will elapse. This time ϵ_2 is entirely independent of ϵ_1, but is due to the same general cause, namely, the time necessary for the armatures of the coils to move. Then again the distance δ will be that which separates the simultaneous indications of two pens, that is, the distance between the marks made by the pens when the paper is not unrolled. We will suppose this distance to be expressed in time; that is, as a function of the length of one second on the paper band when it is unrolled.

Supposing that we use the third clock to reduce an observation. We measure the distance of the point B at the beginning of the mark of the second pen and express this as a fraction of a second, calling t_3 the result thus obtained. To calculate the clock correction we ought to take the difference between the sidereal time θ and the time indicated by the chronograph at the time θ, that is, at the instant of contact. The measured distance will therefore be too large, because it is composed of the time elapsing since the origin of the preceding second, augmented by $\epsilon_2+\delta$. It is, there-

fore, necessary to replace t_3 by $t_3-(\epsilon_2+\delta)$ and we will then have

$$C_p^3=\theta-t_3+(\epsilon_2+\delta).$$

If we use the second clock to reduce an observation it would be necessary to proceed from the point A, since this point is the origin of the new second. We will then have another reading of the chronograph, which we will call t_2, and by repeating the reasoning stated above we will have

$$C_p^2=\theta-t_2+(\epsilon_2+\delta).$$

From this it is obvious that

$$t_2=t_3+\epsilon_1',$$

so that we can write

$$C_p^2=\theta-t_3+(\epsilon_2+\delta-\epsilon_1')=C_p^3-\epsilon_1'.$$

This last result was evident before because, the origin of the second being separated by ϵ_1', the second clock will be ϵ_1' ahead of the third.

Lastly using the first clock to reduce an observation, we do not find any indication on the chronograph of the origin of the second but we know that it has taken place at a time ϵ_1 before the point A. The reading of the chronograph will therefore be $t^2+\epsilon_1$, and by reasoning as before we can write

$$C_p'=\theta-t_2+(\epsilon_2+\delta-\epsilon_1),$$

giving the relations

$$C_p'=C_p^2-\epsilon_1=C_p^3-\epsilon_1-\epsilon_1'.$$

Therefore from what has preceded it is easy to see that to obtain the correction of one of our three clocks we must know one of the quantities $\epsilon_2+\delta$ or $\epsilon_2+\delta-\epsilon_1$.

As we will see in the next chapter, to make the comparisons of the clocks we must be able to perceive in the telephone receiver a sound coincident with the origin of the second of the clock employed.

To make use of the first clock it will be sufficient to put one of the circuits of the telephone in the circuit of the clock, so that the instant when the circuit is completed, that is, at the beginning of each second, we will hear the sound corresponding to this closure.

To use the third clock we put the telephone in the secondary circuit of an induction coil of which the primary contains a micro-

phone fixed to one of the bobbins C of the chronograph. By this arrangement every time the palette strikes the electro-magnet the noise of the shock will be easily heard in the telephone.

It is very clear that it would not be difficult to use the second clock, so that we will not explain its connections.

From the explanation of the clocks given above it is easy to see that we can measure the quantities $\epsilon_2+\delta$, $\epsilon_2+\delta-\epsilon_1$.

It is easy to imagine, without describing the modifications in the electrical connections, that we can close the circuit of the clock and the circuit of the telescope at the same instant. Calling t the sidereal time at this instant, the palette of the clock will commence its movement at the time $t+\epsilon_1$, which corresponds to the point A and the second palette begins its movement at a time $t+\epsilon_2$. Again the second pen is at the distance δ from the first, so that the distance between the first points of the two notches will therefore be $\epsilon_2+\delta-\epsilon_1$.

It is necessary that the two pens of the chronograph be actuated by the same battery. In the circuit of the clock pen we introduced a resistance equal to that of the bobbins of the observation pen, and in the circuit of the observation pen we placed a resistance equal to that of the bobbins of the clock pen. By means of milliammeters we can regulate these two resistances and by means of a system of switches, by putting our two circuits in series on the battery, the distance between the marks of the two pens will give $\epsilon_2+\delta-\epsilon_1$. This method allows us to use the first clock.

Supposing now that the installation described above has been made on our chronograph, as we have said, the switch γ should be open and the switch δ closed during the observations. At a given instant γ is closed and δ opened. Then every two seconds the circuit of the observation pen will be closed by the palette of the clock at the instant when it completes its movement, that is, at the origin of the second of the third clock. The distance between the point B' of the notch of the clock pen and the first point of the notch of the other pen will evidently be equal to the retardation $\epsilon_2+\delta$. Again, in this second case it is not necessary to have one single battery to actuate the two systems of bobbins of the chronograph.

It is easy to see in what manner this last method, which allows us to use the third clock, is simpler than the preceding and we

have therefore been naturally led to adopt it. We will see in the following chapter how we have proceeded for the comparisons of the clocks. During the preliminary researches, which were made before we finally constructed our installation, it was necessary many times to call into consultation M. Jules Baillaud, whose zeal and great competence were of very great assistance.

7. *Procedure of an Evening's Observation.*—Each time that the atmospheric conditions were favorable the observations were made, adhering to the following programme: After having verified all the electrical connections, the position of the switches and the table, and the different parts of the telescope, and having put the chronograph in motion, the astronomer places the telescope in each of its two positions. This determination was not made to obtain the value of the collimation, because we have no need of it, but to be able to detect any possible variations of the azimuth of the telescope during the course of the evening.

We proceed then to measure the retardation of the observation pen on that of the clock. To do this we close the switch γ and open δ and record twenty signals of this kind on the band of the chronograph.

We then replace the switches in their ordinary positions and pass to the stellar observations. A complete evening's observation ought to consist of two parts, comprising ten or twelve hourly stars and two circumpolars each, each part lasting about two hours. We commence by giving a time signal to the chronograph, and then for each star we follow strictly the procedure indicated above, with a simple leveling for each position of the telescope.

At the finish of the first part we proceed to a new determination of the retardation of the pens in one position of the telescope without reversal. At this time we also interrupt the stellar observations to make the comparisons of the clocks by means of the radio-telegraph.

These comparisons finished, we return to the stellar observations. The second part of the evening is as closely identical as possible to the first except that in the beginning we make the determination for the retardation of the pens in only one position and at the end we make the determination in two positions of the instrument.

CHAPTER II.

RADIO-TELEGRAPHIC COMPARISON OF THE CLOCKS.

1. *Principle of the Method.*[13]—To determine the differences of longitude it is essentially necessary that we know the hour indicated by each of our clocks at some predetermined instant and the radio-telegraph gives us an easy method of accomplishing this result. We can easily imagine that we can send out Hertzian waves from some point on the earth's surface, such that they will be perceptible in each of our two stations. Admitting that the velocity of transmission of these waves is infinite, they will arrive at the two stations at the same instant and it is only necessary for us to know the time of our two clocks at this instant to be able to compare them to one another.

In view of obtaining very great precision in this comparison, we have had recourse to the method of coincidences. At the sending station we installed a clock which was so regulated that it ran a little slower than the sidereal clock. In general, 89 beats of this clock equal 90 sidereal seconds, so that twice in three minutes a beat coincides with the second of any sidereal second. At each beat of this clock a Hertzian wave of very brief duration was sent out and in each station the astronomer receives in his telephone the sound thus produced, and at the same time that which indicates the origin of his clock. As we will indicate later, the astronomer has a regulating system to obtain equality in the intensity of these two sounds. At the instant that he estimates a coincidence he notes the time by giving a signal to the chronograph.

The coincidences have naturally not taken place at the same instant in the two stations and it was necessary to reduce them to one another. With this in view, for every sixty beats of the clock there was an interruption in the emission of the waves and each observer noted the instant of these interruptions. By means of a calculation which is perfectly obvious, and which will be described in one of the following paragraphs, we can know the time by each clock at the instant of each of these interruptions, that is to say, at some predetermined instants which are the same for each of the stations.

In assuming that the velocity of the waves is infinite we have said that the position of the sending station was immaterial to the

[13] As we have said above the idea of this method and its first applications were due to MM. Claude, Driencourt and Ferrié.

condition that the waves were perceptible in each of the two points. But as this hypothesis is not strictly true, because the velocity has a finite value, we have made use of two sending stations, situated respectively at points close to where the astronomical instruments were installed. At Paris the sending station was that of the Eiffel Tower, and at Bizerte it was the maritime arsenal of Sidi-Abdallah. Each of these two stations proceeds in turn, as we will describe later, and from each of the two sendings we deduce a value for the difference in longitude. The half sum of these two values will give the longitude independently of the velocity of propagation of the waves as long as their half difference gives the time necessary for the waves to traverse the distance between Paris and Bizerte.

2. *Sending Stations and Receiving Apparatus.*—The installation of the sending stations at Paris and at Bizerte is entirely due to the genius of MM. Claude, Driencourt and Ferrié. As very precise and detailed descriptions of these installations have been published many times[14] we will omit them here and content ourselves with indicating the publications in which they can be found.

For the receiving set at Paris we first occupied ourselves with a system of antennas. After several experiments and with the aid of the commandant M. Ferrié, and the officers of the geographical service of the army, we confined ourselves to the following installation: Three masts ten meters high were placed on the upper terrace of the observatory and a ladder 20 meters long was set up by the captain M. Durand on the Arago boulevard in the grounds of a building which contained a small equatorial instrument. A wire conductor led from one of the masts of the upper terrace to the ladder back to the second mast, then to a large elbow on the side of the building, and finally back to the last mast. The upper branches of this kind of W were fastened together by a transverse wire.

This installation, constructed by the radio-telegraphic service of the Eiffel Tower, worked perfectly during the entire duration of our determination and allowed us to clearly perceive in our telephones the signals sent out from the post at Bizerte, situated at more than 1500 kilometers from Paris.

[14] See Comptes rendus de l'Académie des Sciences, 7 février, 21 novembre 1910 and 1 mai 1911 and Revue générale des Sciences du 30 juillet 1911: Emploi de la télégraphie sans fil dans la détermination des longitudes; see also the Rapport déjà cité of MM. Claude, Ferrié and Driencourt.

The sending set of the Eiffel Tower was more powerful than that at Bizerte and consequently antenna difficulties did not present themselves at this latter station. The ordinary antenna of the arsenal of Sidi-Abdallah was sensitive enough to enable us to hear the sounds sent out at Paris.

For the receiving boxes the conditions were exactly the same. At Bizerte the ordinary box was sufficient for our purpose, while at Paris we had recourse to a receiving apparatus which contained detectors of very great sensitiveness and which were supplied by the radio-telegraphic service.

This receiving set was placed in a small pavilion in the garden of the observatory at some distance from the meridian room, where we installed the time-measuring instruments. A wire from the antenna led to the receiving box and the leads to the telephone headpieces were attached to binding posts of the apparatus. One of these wires led through the secondary of a small induction coil, of which the primary was in circuit with a battery of Leclanché cells. This circuit led to the meridian room to a microphone which was made fast to the coils of the chronograph which served to move the clock pen. From there the circuit returned to the receiving pavilion, where it passed through a graduated rheostat before it completed the circuit. Finally two wires, connected by a switch, led from the receiving pavilion to the binding posts *b* and *c* of the chronographic table and allowed us to move the second pen of the chronograph and thus mark the signals at the will of the observer. The installation of the receiving set at Bizerte was made exactly similar to the one in Paris.

3. *Comparison of the Clocks.*—Every day, except Tuesdays and Fridays, the programme of signals was arranged in the following manner: At 9.35 Paris sent out a series of preliminary signals lasting four minutes and which were intended to help regulate the apparatus. After having tuned the receiving sets so that we obtained a clear sound in the telephones the observer varied the resistance of the microphone circuit in order to obtain equality in the strength of the sounds. After an interval of one minute the same station sent a series of beats for six minutes with an interruption every 60 beats.

The sending station at Bizerte proceeded in the same manner, except that they sent successively two six-minute series of beats instead of one.

Finally the programme was completed by a six-minute series sent out by the Paris station.

Tuesdays and Fridays, on account of the exigencies of the service of the Eiffel Tower, the time at our disposal was limited and we only received two series of beats sent out by Paris.

During the series of six-minute beats the observer followed with great care the two sounds which he heard in his telephone, and at the instant that a coincidence between them occurred he pressed the button of the switch which he held in his hand, giving a signal to his chronograph. Immediately after a coincidence he cut in resistance in the microphone circuit until he could not hear the sound of his chronograph. He then waited for the interruption in the beats and at that instant gave another signal to the chronograph, taking care that this second signal was easily distinguishable from that of coincidence. He then replaced the rheostat in the original position and noted again the instant when the sounds were in coincidence, and continued thus until the end of the series, alternating as far as possible the observation of coincidences and of interruptions.

An assistant, stationed close to the chronograph, watched the movement of this apparatus as well as the marks of the signals given by the observer.

The theoretical conditions which have been indicated were in general carried out; however, it so happened that on especially warm evenings and during several small storms during the last of May the beats sent out from Bizerte were hardly audible in Paris, and *vice versa*.

One will see, however, in the second part of this work that in spite of very unfavorable weather we were able to receive a number of beats which were sufficient to allow us to reach some very interesting conclusions.

4. *Calculation of the Longitude by the Method of Coincidences and Interruptions.*—We can take either the beats sent out from Paris or those sent out from Bizerte. Taking for example, in the first case, the beats sent out from Paris, the astronomer at the observatory was in general able to note all the coincidences which took place during the twelve minutes of sending. There were but few times when an interruption corresponded with the sounds from the chronograph, and when they did, the corresponding coincidence could naturally not be recorded.

We were able to know with accurate approximation the number of sounds which separated two consecutive coincidences. Calling a this number, $a-1$ beats will have occurred during a seconds, that is to say, we will have

$$1 \text{ beat} = (1+\alpha) \text{ secs.}$$

where

$$\alpha = \frac{1}{a-1}.$$

Calling n the second at which a coincidence occurs after the indication of the chronograph, it will be a whole number. The next interruption will be recorded at an instant $n+p+\epsilon$ after the first, p being a whole number and ϵ a fractional part of a second. I will assume at first that p has a value smaller than $a-1$. The fraction ϵ will then be less than 1. Between the instant of coincidence and that of interruption p beats will elapse, but p beats equal $p\ (1+\alpha)$ seconds and consequently

$$\epsilon = p\alpha.$$

It follows from this that at the instant of the interruption considered, the time marked by the clock at Paris was $n+p+\epsilon$, and consequently the sidereal time was $n+p+\epsilon+C_p$.

In some cases it was impossible to record the interruption immediately following the coincidence considered and in this case the observer noted the next interruption. Suppose, for example, that we have

$$a < p < 2a.$$

It is easy to see without much difficulty that in this case it is necessary to replace p by $p-1$ and that the sidereal time at the instant of interruption noted is

$$n+p-1+(p-1)\alpha+C_p,$$

which is equivalent to $n+p+(p-a)\alpha+C_p$. If the observer is not able to note each interruption after a coincidence, but has a starting point with an interruption, calling n the time of coincidence, and $n-p-\epsilon$ the time of interruption, he will have for the sidereal time $n-p-p\alpha+C_p$, provided that the absolute value of p is less than $a-1$.

The different examples that have been indicated will suffice to show how we can proceed in all cases.

Passing now to the case where the beats have been sent out from the station at Bizerte: To obtain the value of a and consequently that of α we must consider the coincidences which were noted by the observer at Bizerte. Once having obtained these values the calculation is continued as explained.

Granting this, if t is the time by the clock at Paris at the instant of an interruption, C_p the correction of this clock, and t' and C_p' the same values for the clock at Bizerte, then for the same interruption, if l designates the absolute value of the difference of longitude, we will have

$$t'-t=l+C_p-C_p'.$$

This relation permits us to distinguish between an interruption noted at Paris and those which are noted at Bizerte, and *vice versa*. In this application the calculation given above for the coincidences recorded at Paris and Bizerte will give the sidereal time at the two stations at the same instant, and the difference between these two times will give the desired difference of longitude.

Example: On April 19, 1911, during the sending by the Eiffel Tower station we observed at Paris an interruption at $11^h\ 33^m\ 7^s+\epsilon$ in clock time. From the meridian observations made the same day we determined

$$C_p=+0^s.11 \qquad C_p'=-6^s.53.$$

Using values of l approaching $29^m\ 52^s.4$ we have for $t'=12^h\ 3^m\ 6^s$.

For the interruptions noted at Bizerte we found that $t'=12^h\ 3^m\ 6^s+\epsilon'$.

At Paris we had a coincidence at $11^h\ 20^m\ 24^s$. $p=2^m\ 43^s$.

At Bizerte we had a coincidence at $12^h\ 3^m\ 46^s$. $p=-39^s$.

From coincidences observed at Paris during this sending we we found

$$a=103, \qquad \alpha=0.0098.$$

Finally we conclude that at the instant of interruption,

Sidereal time at Paris $=11^h\ 33^m\ 7^s.7$.
Sidereal time at Bizerte $=12^h\ 3^m\ 0^s.09$.
Difference of longitude $=29^m\ 52^s.39$.

5. *Calculation of the Longitude by the Method of Coincidences Alone.*—When the atmospheric conditions are such that the signals are weak it becomes very difficult to record the interruptions, but

results can be obtained if the coincidences can be detected. By this method a result approaching very closely the difference of longitude can be obtained.[15]

Calling b a whole number of beats, the time elapsing during this interval will be a certain number of seconds of the form $n+f$, n being a whole number and f a fraction less than unity. Calling a, as usual, the number of seconds corresponding to the number of beats between consecutive coincidences and putting

$$1+a=\frac{a}{a-1} \qquad a=\frac{1}{a-1}.$$

The number $n+f$ can be greater than a.

Thus $n+f=aq+a\rho$, q being a whole number and ρ being less than one. From this we will have

$$\rho a<a.$$

But we always have

$$b(1+a)=n+f.$$

Replacing $n+f$ and $(1+a)$ by their values,

$$\frac{ab}{a-1}=aq+a\rho, \quad b=(a-1)q+(a-1)\rho, \quad ba=q+\rho.$$

From which we deduce that

$$b+q+\rho=n+f,$$

and since b, q and n are whole numbers and ρ and f fractions less than 1,

$$b+q=n, \qquad \rho=f.$$

We have consequently

$$n=aq+(a-1)f,$$

where

$$(a-1)f<a.$$

If, therefore, we divide n by a, q will be the whole quotient, and if we call r the remainder from this division we will have

$$r=(a-1)f, \qquad f=ra.$$

Now putting

P the time by the clock at the instant of a coincidence observed at Paris;

B the time by the clock at the instant of a coincidence observed at Bizerte;

[15] The idea of this method of calculation was suggested by Captain Bellot.

l_0 a value closely approximating the difference of longitude between Bizerte and Paris;

$l_0+\Delta l_0$ the exact value of this longitude. In the present case l_0 will have a negative value.

Calling again C_p the correction of the clock at Paris, C_p' that of the clock at Bizerte and calling

$$B'=B+l_0+\Delta l_0+C_p'-C_p,$$

B' will be the time by the clock in Paris at the instant of a coincidence observed at Bizerte. $B'-P$ will give the elapsed time from the coincidence observed at Paris and the coincidence observed at Bizerte. This number $B'-P$ is not a whole number of seconds, but it is evident that it corresponds to a whole number of beats. We can therefore apply the preceding reasoning to it, except that we do not know Δl_0. Putting

$$B_0'=B+l_0+C_p'-C_p,$$

and calling $n+f$ the number of seconds and fractions of a second contained in the expression $B_0'-P$ we can calculate this number, but in the analysis above it will be necessary to replace $n+f$ by $n+f+\Delta l_0$, that is to say, f by $f+\Delta l_0$. We will have therefore

$$f+\Delta l_0=r\alpha, \qquad \Delta l_0=r\alpha-f,$$

from which we will know Δl_0.

Example: Recalling the case of April 19, 1911, cited above, and using for l_0 the value $-29^m\ 52^s.4$ we have

$$\begin{aligned} B &= 12^h\ 03^m\ 46^s. \\ B_0' &= 11^h\ 33^m\ 46^s.96. \\ P &= 11^h\ 30^m\ 24^s. \\ B_0'-P &= \quad 3^m\ 22^s.96. \\ n &= \quad 3^m\ 22^s. \end{aligned}$$

We deduce from that that

$$r=99^s, \qquad r\alpha=0^s.97, \qquad f=0.^s96,$$
$$l_0+\Delta l_0=-29^m\ 52^s.39.$$

6. *Conclusions.*—In the first part of these two methods of calculation which have been indicated one can evidently see that in general in one or the other of the two stations we can associate any of the observed coincidences with a given interruption, provided that the times noted for this interruption agree with one another.

But to be strictly correct our calculation supposes that the value of a was absolutely exact, but in fact this is never the case. In practice, the greater the elapsed time between the coincidence and the interruption the greater will be the incertitude in the difference of longitude obtained.

Evidently, in principle, it is better to associate with each coincidence the interruption closest to it which has been noted in the two stations, and to assign different weights to the values obtained according to the elapsed time between the observations.

The same reasoning holds true for the second method of calculation, as in general this is the method which is the easiest to use in practice. We will develop a few of the considerations which affect the precision of the result.

It is clear that what one notes as a coincidence is the instant when the two sounds perceived in the telephone are the closest together, but that, in general, absolute coincidence does not exist. Depending upon whether this ideal coincidence is close to or far away from the coincidence noted, the observation will be more or less accurate. One cannot therefore say that all observations have the same precision. The errors introduced can be ordinarily regarded as accidental errors and it will be useless to combine each coincidence observed in one of the stations with all that can be noted in the other during the same series, taking care to apply different weights to the values, as we have said above.

We suppose at first that the quantity which we have designated by a is absolutely exempt from error. For this case the reasoning given in the preceding paragraph is applicable, but it is necessary that the number of beats b, be a whole number. If the coincidence observed was strictly exact, the quantity $B_0'-P$ will express a whole number of beats, and consequently the difference $r_a-f-\triangle l_0$ will be negligible, but this is not the case in general.

We refer everything back to the beat noted as coincidence and the error thus introduced will be attributed to the time given by the clock at the instant of this beat.

This error springs from two different causes: First, an exact coincidence does not occur; second, the even second observed can easily not be that when the two sounds in the telephone are the closest together.

If our clock beats every two seconds it is easy to see that the first error cannot exceed the value of the quantity α. Admitting, further, that the observer was so skilled in the observing of coincidences not to be mistaken more than the interval corresponding to two consecutive beats of the clock, we conclude that the total error cannot exceed 3α.

The quantity $B_0'-P$ was deduced from two consecutive coincidences observed, one at Paris, the other at Bizerte. We can, therefore, in the number $n+f$ regard the whole number n as exact and the fraction f as liable to an error less than 6α.

It is necessary also to take into account the fact that the quantity a may also be in error. In reality this quantity represents the time necessary for our sidereal clock to execute an oscillation greater than that of the clock sending out the Hertzian waves. If, in practice, the coincidences occur exactly, this time includes a whole number of seconds, but it is easy to reach a condition where a will be fractional. With the precautions taken for this calculation we can admit that the error introduced will always be very small. We will suppose in what follows that it will not surpass $0^s.5$.

Thus putting n, f_0 and a_0 the quantities found by the observation, f and a being the exact value, and putting

$$a=a_0+\epsilon, \qquad f=f_0+\epsilon'.$$

Adopting the same notations for α and α_0

$$\alpha=\alpha_0+\eta,$$

we will have

$$\eta=\frac{1}{a-1}-\frac{1}{a-1+\epsilon}=\epsilon a a_0.$$

Then again from

$$r=n-aq, \qquad r_0=n-a_0q, \qquad r=r_0+\eta',$$

we will find

$$\eta'=(a_0-a)q=-q\epsilon.$$

Deducing from this

$$r\alpha=r_0a_0+r_0\eta+a_0\eta'+\eta\eta';$$

that is to say, if we put

$$r\alpha-f=r_0a_0-f_0+\zeta,$$

we will have

$$\zeta = r\alpha - r_0\alpha_0 - (f - f_0) = r_0\eta + \alpha_0\eta' + \eta\eta' - \epsilon,$$

neglecting the product of errors,

$$\zeta = r_0\epsilon\alpha\alpha_0 - q\epsilon\alpha_0 - \epsilon'.$$

So that we shall have

$$\triangle l_0 = r_0\alpha_0 - f_0 + \zeta.$$

From this we see that ζ will be the correction which must be applied to the calculated value if one knows the errors ϵ and ϵ'.

In the expression for ζ, the first term will always be small; therefore $r_0\alpha_0$ is always less than unity and consequently this term will be less than $\epsilon\alpha$. We might remark in passing that, because of the change of sign of r_0 the influence of this term will be eliminated in the middle if we take care in combining each observed coincidence in one of the two stations with all those which have been noted in the other, both before and after it.

The value of the second term is proportional to q, that is to say, the error increases as the coincidences are farther apart. Here we depend upon the principle traced out in the second part of this paper for the different values obtained.

In résumé: It seems that in the system employed for the comparison of the clocks one would not expect to find causes of systematic error in the personal equation for the appreciation of coincidences, but we can hope to eliminate it by the exchange of observers. For the determination of the correction of the clocks the personal equation of the observation of the stars is rendered extremely small by the use of the recording micrometer and is eliminated by the exchange of observers. Our system of measurement for the retardation of the pens of our chronograph seems to be sufficiently precise so that we need have no fear of accidental errors.

DISCUSSION.

Organization for Navy Department Administration.

(See No. 146, p. 435.)

CIVIL ENGINEER P. L. REED, U. S. Navy.—The paper on "Organization for Navy Department Administration" evidently represents much thought and research and is based on a painstaking analysis of the elements of organization. It is, however, permeated by a conception of the precedence and relative importance of the elements of industrial and, by analogy, naval organization, which, it is believed, can be shown to rest on no more solid ground than individual or class opinion, and which vitiates its conclusions.

Before discussing this feature of the paper, some comment seems called for on the references to business organizations, from which support is claimed for the precedence features of the proposed naval organization.

The paper states that there are two forms of management known to business men: (1) the hierarchical and (2) the functional. The characteristic of the former is explained as a single line of authority extending downwards without any co-ordinate subsidiary authorities. It is believed that no large business is or could be conducted on this plan and that its consideration can be of no more than academic interest. Every large manufacturing establishment, department store, railroad or military organization has many co-ordinate heads of divisions, departments, sections or companies.

The form (2), described as "functional," is the most common type of industrial organization, in which authority is transmitted from one head in radiating lines to sub-heads, and again in radiating lines of lower order to subordinates of lower grades. This type is represented by Fig. 4, in the discussion of Naval Constructor Roberts. This organization corresponds to that of an army and is sometimes called the military type.

The term "functional" is applied (originally, it is believed, by Mr. Frederick W. Taylor, author of "Scientific Management") to a third type of organization in which chiefs, superintendents or foremen are given co-ordinate authority, each over certain definite and independent functions, or groups of functions, of the same body of subordinates. It has been applied in shops operating under "scientific management" by substituting for one general foreman, with entire authority over all the workmen in a shop, a number of separate co-ordinate foremen, such as a "speed boss," in charge of the operation of machines, a "gang boss," whose duty it is to see that the work is properly routed through the shop, that each operator is kept supplied, avoiding waits, and that operators are given necessary manual assistance in placing and removing work, a "shop disciplinarian," etc., each with independent authority in his own field or function over the same body of workmen. An analogy is found in certain features of rail-

road organization. The station agent at a small town receives independent orders from a number of general officers, such as general ticket agent, general baggage master, general freight agent, general passenger agent and train dispatcher. In the navy, similarly, the chiefs of bureaus issue, under the general authority of the Secretary, independent instructions to the same commandants.

It will be noted that the last type of organization corresponds, in a general way, to that illustrated in Fig. 3 of Naval Constructor Roberts' discussion. Investigation will show that there are few large organizations actually operated purely as illustrated by the military type (Fig. 4) whatever the original theory of the organization may have been. To avoid circumlocution, delay and "red tape," lines of cross authority (illustrated in Fig. 3) spring up, notwithstanding the weakening of lines of direct authority and responsibility and the danger of misunderstandings and conflicting instructions. These disadvantages are, of course, reduced the more definitely the respective functions can be defined and separated.

Passing to the next division of the paper, the organization of a business enterprise, evidently of an industrial character, is said to consist of three branches: (1) Internal, (2) External and (3) Inspection. It can be stated at once that such a division greatly magnifies "Inspection." In many large manufacturing concerns there is no distinct "inspection" branch; and, in all, it is insignificant in comparison with the "internal" (producing) and "external" (selling) branches. It is safe to say that in most concerns it exists only in the play between the purchasers and the internal branch, transmitted through the external branch, and in the lessons learned and reviewed from time to time by the internal branch in consequence. Even when there is a definite inspection subdivision or division, it is always, in industrial enterprises, a part of, or offshoot from, the internal (production) branch rather than the external (selling) branch.

Notwithstanding this condition, the paper attempts to found on business practice a recommendation that in the navy there should be an independent inspection branch and that it should be a part of, or allied with, the external branch. *E. g.*, "The inspection branch, directed by the class to which belongs the conduct of war, should inspect the work of both the command branch and the civil branch." Further along it is stated, "it becomes the duty of the military branch to make research into history . . . . and keep . . . . informed upon the practices of foreign . . . . navies and its own military resources. From these studies is derived the knowledge to inspect the output of the civil branch in quality and quantity and to be assured that this output is suitable for war." Surely the lessons of history and the present practices of foreign navies, as regards *materiel*, are quite as open and intelligible to the internal or construction branch as to the external or operating branch.

Again, it is believed that the following strong statement in the paper is not justified by the facts in the business world, "as the object of business is revenue, it is self-evident that the internal branch will conduct its work in accordance with the plans of the external branch, as formulated by the latter, in order to satisfy the customers." It may be stated with equal

approach to the facts that it is self-evident that the external branch will conduct its work so as to place, where it will be employed to best advantage, the output of the internal branch, in order to please the customers. The truth lies about midway between.

The paper has, in fact, established no precedence or superiority of the external branch in business and the attempt to obtain support from it for a naval organization in which "superiority or precedence must be confined upon that side which plans and directs the war (external branch) in preference to the side which provides the means necessary to support the war (internal branch)" fails.

To be erected on this false or non-existent foundation of business practice an edifice is planned, the keystone of which is that the operator of a machine should be held superior to its builder and that in the naval organization his authority and responsibility should be paramount.

Since the paper bases its plan for naval organization on industrial business organization, it may be worth while to glance at the way such things go in commercial industry and other fields.

On a railroad the characteristics of the locomotives and cars are not fixed by the locomotive engineers, conductors or brakemen more than by the shop superintendents, foremen or machinists. They are fixed by correspondence and discussion in which representatives of the operating side bring out the relative advantages of various features from the operating standpoint and representatives of the construction side bring out the relative costs and sacrifices involved. Final action is taken by a common chief who has risen to his position through railroad construction quite as frequently as through railroad operation.

Certainly the characteristics of an Atlantic liner are not determined in any large measure by the views of her officers.

The world is more interested in who is to design Sir Thomas Lipton's cup challenger than in who is to sail the yacht, if one may judge from the newspaper items.

It is probably a safe assertion that Ericsson designed the *Monitor* without following a schedule of characteristics furnished by those who were to control her operations, and it is certain that history has made his name more familiar than those of the gallant officers who fought her so well and with such far-reaching results.

In fact, in all the history of material advance, responsibility and honor have been accorded to the great inventors, engineers and constructors in no less measure than to those who used these means towards the accomplishment of ends.

An examination of the interesting organization diagrams representing the Moody, Meyer, Esher, Luce, British Admiralty, German and French navies, brought together in such concise and comparative form, furnishes little or no support for the subordination of the material element insisted upon in this paper and in the resulting plan of naval organization recommended.

It is believed that it has been shown to have no foundation on existing commercial organizations, and is without historical support.

Naval Industrialism, Naval Commercialism and Naval Discipline.

(See No. 146, pp. 536 to 550.)

COLONEL GEORGE RICHARDS, U. S. Marine Corps.—The essay of Commander W. W. Phelps, appearing in the June issue of the UNITED STATES NAVAL INSTITUTE PROCEEDINGS, invites renewal of the old-time discussion as to the wisdom of the present policy requiring sea service of marines on vessels constituting the first line of defense. The writer presents no new reasons in support of his cause; his paper is one along lines similar to those of other essays touching this subject similarly published during the past twenty years. That cause the writer purports so to advance, to wit: the uplift of the bluejacket, is a most worthy one. It should command the support of all naval officers, whether they be of the line, the staff corps or the marines. As a naval officer of the latter class, it is due me here to state, in no uncertain terms, my hearty sympathy in Commander Phelps' effort to institute a better system of training for the American bluejacket. Seventeen years ago, a marine officer, in a similar situation and on this same subject, said:

"The assertion is continually made in the essay that marines afloat prevent the development of the sailor; this is not so. Nobody is or can be responsible for the development or non-development of the sailor but his officers and himself; the matter rests solely in themselves. There is no law or regulation to prevent sailors from performing sentry duty or being orderlies to commanding officers, for purposes of instruction or otherwise; instruct them in guard duty; give them military instead of naval training, if you would better meet the requirements of the navy, but don't begin by dispensing with marines, the only military body in it, and then attempt to bring sailors up to their military standard, for, from the very nature of attending circumstances, a good sailor would be spoiled in making a poor marine. As the essayist elsewhere suggests, encourage sailors to be self-respecting and trustworthy by putting responsibility on them and trusting them; give petty officers charge of squads or guns, etc., at drill; put him in charge of a boat or a working party without an officer to watch him, but don't put the onus of poorly trained, unreliable petty officers and sailors (if they are so) on marines. 'Tis a poor subterfuge, as unkind as it is unjust."

It is most assuredly in the interests of naval discipline and efficiency to perfect in the enlisted personnel of the navy the self-same spirit of initiative and sense of individual responsibility as now obtain in the marines. But to institute these essentials of a military system, to perfect among the bluejackets an *esprit de corps* requires much more than Commander Phelps outlines. The presence of marines on sea-going vessels is not now, nor ever has been, an obstacle in this relation. If sailors are to be made military, it rests with the line of the navy to make them so and the example of the body of subordinate, well-trained marines should be a help, rather than a hindrance to this development in the bluejacket of a military

spirit. No thoughtful officer of any branch of the service now asserts that the sea service of the marine is required in the interests of naval discipline.

In more recent years, Vice Admiral Sir Reginald Neville Custance, Royal Navy, has said, with reference to this question as it has arisen in the British service:

"No question is so little understood as the relation between the marines and the navy. That useful and renowned corps was not originally formed as an instrument to repress the seamen, but because it provided cheaply and readily a supply of reliable and disciplined men to complete deficiencies when the fleet was mobilized. It is true that in the end experience showed the marines to be a useful counterpoise to the seamen, but this advantage was quite secondary. Necessity begot them in the distant past, necessity has prolonged their existence to the present and necessity will continue their being in the future. . . . .

". . . . We repeat that marines are, and always have been, enlisted to facilitate the manning of the fleet. What are their characteristics: Cheapness, discipline and want of nautical skill? Their discipline is due to their military method and to military drill, which is the quickest method of getting men in hand and of making them available for war. Hence they are particularly valuable when a rapid expansion of the naval personnel is required. Their want of nautical skill is of no moment, as on board all ships, whether sailing or steam, a large amount of unskilled work must be done, for which they are well suited. Their cheapness is due to their want of nautical skill and to the comparatively short training required. . . . .

". . . . To the military mind drill is the foundation of discipline and order; to the naval mind nautical skill is the basis on which rest the training, organization and discipline of the fleet. It so happens that during the past generation the naval officer and man has gradually lost the principal part of his nautical skill, owing to the disappearance of sails. He has shown a strong tendency to replace this by military drill, but has never altogether reconciled himself to doing so."

Commander Phelps voices the views of a school of officers of the line with this self-same tendency to replace nautical skill by military drill. This school has its origin in the measures advocated by that distinguished line officer referred to by Commander Phelps as "a far-sighted master of naval discipline," who twenty-three years ago initiated this self-same controversy. Throughout the discussion as then obtaining and in their renewal in 1896 and in the paper now brought forth by Commander Phelps, there never has appeared even the outline of the plan through which it is expected that this military system is to be perfected. Nor have we learned that any substantial policy has obtained during these twenty-three years to create in the "petty officer" the qualities we now possess in the "non-commissioned officer of marines." That has been left entirely in the hands of individual officers, while the whole responsibility for this alleged lack of development is unfairly laid upon the fact that some 2500 marines serve afloat amongst about 45,000 bluejackets. It should have been well recognized in 1890 that the mere removal of the marine from the ship cannot alone make the bluejacket become what that marine is. That marine is the product of a system,

a system with which the officers of marines, at least, are familiar. The knowledge acquired by us is no inheritance from Annapolis. We graduates of that institution now in the marines owe largely to the enlisted marine, himself, especially to the old soldiers who are the backbone of the service, whatever we may now possess in this relation. With no information in the line of the navy as to the means necessary to accomplish what Commander Phelps desires, with but little data in hand as to the details of the system under which the military spirit may be perfected in the bluejacket, with no practical experience amongst the commissioned personnel of the line as to the military art; indeed, with a personnel to whom the details of the business of "soldiering" are essentially distasteful, it is proposed to give up what is real for the sake of a mere theory. We of the marines are not wanting in respect or admiration for the American bluejacket. We would be glad to see him progress. We believe in his uplift. We do not fail when opportunities are afforded to us to express our admiration for him. My own statement before the Committee on Naval Affairs, last January, may be here mentioned, viz:

"The marine works well aboard ship with the sailor; he does his duty to the satisfaction of naval officers generally, and, I may say, on the other hand, that in those instances where the seamen or bluejackets have served ashore they work well with the marines.

"A notable instance of this was told me the other day by a marine officer who had just returned from Nicaragua, where the bluejackets and marines formed a field force landed to suppress disorders there. The whole force of marines and sailors was under Admiral Southerland. This marine officer tells me that at Nindiri, on September 19, a company of sailors had been removed from the assaulting column because their snow-white uniforms presented too favorable a target to the enemy. Learning the cause of this order, these sailors removed their white clothes, rubbed them in the dust and mud until they approximated the khaki color, put them on again, and, in this condition, were permitted to joint the marines in an attack on the rebels.

"Another marine officer tells me that in the big fight there, the attack on Coyotepe Hill, a bluejacket from the *California*, a petty officer, carrying the colors, was one of the first with the marines to reach the enemy's trenches at the top."

Commander Phelps says:

"This is a reform from the standpoint of naval discipline, naval *esprit de corps*, and it cannot be destroyed, though through expediency it may be delayed in being put into effect. Once a proposition is admitted as being for a positive human uplift it becomes a reform, it always remains a reform, it cannot die and it should be constantly fought for. It is not at all impossible that naval legislation can be just as easily influenced in favor of 'special privileges' within the navy, as tariff legislation can be influenced in favor of special privileges dominating politics; and we would then have an example of legislation partaking of the character of naval commercialism."

Commander Phelps perhaps does not know that the Marine Corps, through its official head, the major general commandant, acquiesced in the decision of the President of the United States with respect to the removal of marines from ships in 1908. In fact the President's order effecting that transfer was drawn up by a board of officers of the Marine Corps. General Elliott later explained fully his relation to this question, and from his statement the following may be here cited:

"I told Admiral Pillsbury that we were not ready to die by the slow method of tuberculosis, but if we had to die, would do so with our boots on and leave the ships entirely."

After this removal from the ships, Congress itself took charge of this question. All those who had views either for or against the proposition were invited to appear before its committee. The whole question was threshed out there. All special interests there appeared and the views of that school of officers now represented by Commander Phelps were fully stated before the committee. The case has had its day in court. Commander Phelps now says, in effect, that the reform this school still stands for cannot die, that it should constantly be fought for. Should his contention be approved by the line of the navy? With respect to the views of this school, it may be stated that no officer, however long he may have served, knows the necessities and workings of the navy, except from his own particular standpoint. This is necessarily limited to the narrow range of his own experience and observation. Within this range his views may be eminently sound. But if these views be applied to any general question affecting the entire naval establishment, it is more than an even chance that their adoption will work a grave injury in a quarter beyond the vision of the officer who expressed them and in a matter as to which that officer is wholly uninformed. The man on the "crosstrees" may be better informed as to the danger before us than the "gentleman of the watch." This is a subject that cannot properly be considered except from the broadest possible standpoint. Let us dismiss at once, as unworthy, "corps" interests, or, at least, these so-called special interests. We are all of us naval officers and can meet the issue on a common ground.

In a cause styled "human uplift" it would be well to study conditions as they are, not as we would make them; to take account of the purely human forces that surround all of us and judge, as best we can, what lies at the end of the path Commander Phelps would have us take. He says:

"The man-o'-warsmen were commercialized when the reform to place them under a military system by removing the marines from the ships was temporarily prevented by legislation.

"The difficulty will always be in trying to accomplish this reform, that while the navy's purview would include the sphere of the Marine Corps, the Marine Corps confines its view to the Marine Corps only, not a navy view. The standpoint seems to be the fear that it will mean the loss of their identity. There is undoubtedly no occasion for any such fear. The Marine Corps is too firmly established. It has always had its particular place as an arm of the navy. The navy cannot do without it."

No one could have failed to be impressed, when this entire matter was threshed out in 1909 by the Committee on Naval Affairs, that the status of the Marine Corps was then understood as one by no means "firmly established." A study of the testimony there submitted should convince any unbiased mind that the paramount question under consideration by the various committeemen concerned, not so much the sea service of the marine, as it did the future status of the Marine Corps as a co-ordinate branch of the navy in the general scheme of the national defense. The military establishment of the United States consists properly of land forces and of sea forces; the former come under the War Department, the latter under the Navy Department. Congress has the constitutional power to create or maintain, or not to create or maintain, as it shall deem expedient, a Marine Corps; it has similar power to provide and maintain a navy. The legislative history of the Marine Corps shows that it was created in the very beginning for sea service on board vessels of war. Sea service brought it forth, sea service has perpetuated it, and lack of proper sea service will, without doubt, end its present association with the navy. The questions asked by the various committeemen, during the hearings of 1909, and the testimony adduced, leave no other conclusion but that the legislation which "temporarily prevented" removing the marines from the ships likewise temporarily prevented the transfer of the Marine Corps to the United States Army. Congress decided to cause to be restored to the marine this sea service and so preserve him to the navy. This is a feature of the situation touching a quarter in which it is but fair to presume Commander Phelps is wholly uninformed. Thoughtful officers of marines do not look upon such a transfer as one adversely affecting their personal interests; it cannot be viewed by other naval officers in any other light than one which concerns the interests of the navy. Whatever views it is my duty here to express, with respect to the desirability of assigning officers and men of the Marine Corps to sea-going vessels cannot be disassociated from the alternative Congress then had in mind. Nor are such views based upon my own interests or those of the Marine Corps. My vision is not restricted to the Marine Corps alone; it includes, to the extent that such a condition is humanly possible, a purview of the naval interests, and does not stop short of the interests of the nation, in so far as such interests touch questions concerned in the national defense. It became apparent to all of us who were familiar with the details of the controversy of 1909 that the sentiments of Congress were then to the effect that this country cannot support two armies, one under the navy and the other the army proper. What Commander Phelps advocates is that the Marine Corps be concentrated now into such an army. There is no question but that this is lawful; there is no doubt that in the Executive rests the proper, or constitutional, power so to direct. The sole question to consider is this: Is it wise?

During my own naval service, the corps of marines has increased in numbers and otherwise developed as naval necessities and the needs of our country have required it to develop. We, who are graduates of the Naval Academy and, at the same time, are officers of marines, are now few in numbers compared with the rest of its commissioned personnel. We

Annapolis graduates are not wanting in influence over our commissioned personnel. In it we would foster and develop the naval spirit. We would direct our efforts to what we, with you, conceive to be for the best good of the naval service. For reasons largely sentimental, we would, if permitted, keep together ourselves as commissioned marines and stay with you. Too many of the commissioned personnel of the marines desire this transfer to the army. We have in the past thirteen years temporarily served with the army, both in barracks and in the field; there complete sympathy, as between soldier and soldier, obtained. And, in the last analysis, to descend to more personal and material considerations, it must be clear, should the marines become part of the army, the opportunities for independent command in the field and the corresponding chances for distinction and advancement will be vastly greater. We graduates, who are officers of marines, feel that those early associations with you at Annapolis have left a permanent mark upon us. The influence we possess, which you may increase or diminish, can, in so far as our brothers of the line permit, be exercised for the best good of the naval service. In common with our fellow graduates of the line, we believe that the best good of the naval service requires the perpetuation of measures contributing most to the efficiency of the fleet. When questions arise they deserve to be discussed fully, freely and frankly, but amongst ourselves. We should not work with "watertight bulkheads" between us; we should be relieved of this necessity Commander Phelps creates of laying our differences before the public.

We know the prejudices we all of us acquired as against the marine during our common service at the Naval Academy; we know that "soldiering" then was distasteful to us, that the seaman's term "soldiering on a rope" aptly described to the young naval mind that this was nothing more or less than "loafing." We remember that the enthusiasm this soldier displayed in cheering the victories of our opponents on the football field failed to inspire us with affection for him. We know better than our fellow graduates will now admit that those early prejudices, either actively or passively and unconsciously, represent an influence that may touch questions concerning the marine. We understand the "line" desire that so far as practicable the entire commissioned combatant personnel of sea-going ships be Naval Academy graduates. We understand the fundamental antagonistic causes inspiring all these movements as against the marine, these so-called "reforms." Agitations arising from discussions of this character weaken our influence in the Corps. They are, therefore, distinctly harmful to the success of our efforts directed toward the best good of the naval service.

We know, as do you, that the fleet of today is not the fleet of a century ago, that naval science presents a variety of new conditions. We are ready, with you, to cut free from traditions, to face the new conditions. Among other conditions, we realize that no longer can the fleet maintain itself at sea, ready for conflict, for such extended periods of time as did the fleets of Nelson and Collingwood. The modern fleet requires different methods, through which it may maintain its supremacy. A base of operations, a rendezvous for repairs and for replenishing supplies, is more than ever

before a first essential. But now that fleet, with its horde of auxiliaries, its train, further requires, in extended areas, advanced bases, temporarily fortified, where it can maintain itself at a distance from home in readiness to give battle. Here lies the most important auxiliary service for the Marine Corps, which it, above all, stands ready now efficiently to fulfill. The need of a mobile field force, armed, equipped and trained for the purpose of seizing and defending advanced bases, is now a prime necessity. Such a force, drawn not from the complements of ships of the first line, but organized from the personnel of the proper shore stations and maintained as a separate and distinct tactical unit of the fleet, known as the advance base outfit, is a most important auxiliary of the fleet. A measure, through which it is expected something may be added to the efficiency of a battleship, at the expense of the efficiency of an auxiliary, cannot be a measure that adds efficiency to the whole fleet. If, by divorcing the marine from the sea, perfecting thereupon in your battleships the homogeneous military crew, as is advocated, you add something to efficiency there, what has been gained to your fleet? The efficiency of the whole is measured by the efficiency of all its components. It must be the well-balanced fleet. The strength of the chain is determined by that of its weakest link. Where are you if, in the hope of adding efficiency to your battleships in battle, you deprive yourself of a facility you already have with which you are able successfully to join in battle? Would you first throw away a substance and then grasp at a shadow? Let the marine lose the sea service his very name implies, the service for which he was created, by which he is sustained; let him become wholly a land force, as he will should the views of Commander Phelps become adopted, and you will have lost in him at once more than you may hope to gain elsewhere in all time. Who is there who would sharpen the sword if thereby he weakens the power to wield it?

Institute and foster, if you will, the military spirit amongst your bluejackets, but by other means than depriving the marine of his service at sea. That the Marine Corps is the mobile force it now is, is due to the sea habit, acquired on vessels of the first line by a portion of his corps and distributed from that portion throughout its entire personnel serving elsewhere. The experience that both marine and marine officer acquire at sea as a component part of the ship's organization has a worth to them and to the naval service that cannot be overestimated. It is only by service there that the naval purpose of the marine is realized. The educational value of the wardroom mess to the marine officer is an asset you cannot measure. The familiarity with naval methods acquired by the enlisted marine on board ship, and its effect upon his individual efficiency, is a factor you cannot replace. Through these conditions, through this varied experience of its officers and men, both afloat and ashore, there has been developed, throughout the entire personnel of the Marine Corps, the qualities that make a highly-trained, efficient mobile force of naval infantry ready and available for naval use. Such a force, under the control of the one mind, who directs a future naval campaign, he who is afloat and in supreme command of the sea forces (the commander-in-chief) is a factor most important to the success of such campaign. Questions of divided

authority, which the history of all nations show to have been involved in joint operations of land and sea forces, cannot here arise. With that Marine Corps as it now is you cannot fail to have perfect co-operation. Should that sea service, that duty afloat as a permanent part of a ship's organization, be lost to the marine; should he be relegated to shore duty and merged there into permanent and fixed organizations, with occasional embarkations on naval transports as expeditionary forces for temporary "sea service" as the sole evidence of his naval purpose, what will be the result? There will be lost to the marine that sea habit, and all the other essentials that go to make up that mobility so necessary for the efficient co-operative service of his corps in naval operations. And when his corps becomes so established as a land force segregated from the navy, when it becomes recognized that his so-called "sea service" in naval transports is merely occasional or temporary, that he is, in fact, a part of the land forces and not of the sea forces of our country, then his transfer to the army cannot well be avoided. For "land forces" belong to the army, not to the navy. No one, who has studied the testimony adduced in the hearings of 1909, can doubt this inevitable result. General Elliott's statement should alone convince the unbelieving, for, after his recital of many other significant incidents touching this phase of the situation, he closed with the following:

"About three days after the President's order, assigning us to duty (ashore), a general officer of the army, in conversation with two officers of the corps, expressed a strong desire to embrace the corps into the army as infantry.

"While we had been following quietly our duties, elimination and absorption were casting, unknown to us, their shadow at our heels."

Policy is determined, we may safely say, after a consideration of a given proposition from every angle. The views of the people of the United States, whose money sustains the government, as such are expressed by their representatives in Congress, mark a line, in this relation, beyond which "policy" may not safely pass. What do "initiative," "responsibility" and "discipline" mean? These are terms applying to, or attributes of, a system, the personnel of which falls distinctly into two classifications—one consisting essentially of those who, in a given set of circumstances, do the right thing without being told, the other of those who, in similar circumstances, do the right thing after being told. The first possess initiative, the second are influenced more by a specific responsibility; the whole is controlled by discipline. The basic principle of organization, in fact, the discipline of military bodies rests in the unquestioned necessity for supreme control in the hands of one. The whole aim is to obtain that ideal in which each part shall respond to the will of the commander as quickly and certainly as the muscles of the body respond to the wish of the mind. To attain this perfection, each and every one of the organization, no matter what his rank, duty or branch may be, must recognize not only his own limitations, but those of all others, whether they be the authorities over him or the men beneath him. The system implies that trust shall be placed in those below; it requires that confidence shall, at all times, rest in those

above. He who would command should learn first to obey. A part of that obedience consists not only of respect for the orders of our seniors, but also of confidence in the wisdom of their opinions, their views or their policy. The policy of the Navy Department, upon this very question of the Marine Corps, the wisdom of which no unprejudiced mind can now doubt, is represented by the Secretary of the Navy's views as expressed to the Congress in 1911, viz:

"This corps is primarily an adjunct of the navy, to be used as a mobile force, stationed on board ship, in home ports, and at advanced bases, always ready to act in conjunction with the navy in preserving order beyond the territorial limits and in occupying strategic points in advance of the army when to move the army would occasion war. The number on shore is based on the necessary brigade organization. The number afloat provides a full detachment for each of the large ships of the fleet. Sea service is necessary to keep the corps in touch with naval conditions."

Congress, upon this information as to the Department's policy, coinciding, as it does, with its own views, and with the further and more specific approval of the Secretary of the Navy before it, recently increased the commissioned and enlisted strength of the Marine Corps. These views become, therefore, of added importance to all of us. Commander Phelps would institute in the navy, in the interests of naval discipline, what he describes as a reform. How can the cause of "discipline" ever be advanced through such a disregard of its basic principle? A stream can rise no higher than its source. Questions connected with naval administration constantly arise where we of different branches cannot discover at once our common ground. It is then that the restraints of discipline should be applied to all of us. No one of us should be permitted to rush into print, question the wisdom of the Navy Department and impugn the motives of his brother officers. We lose nothing by taking time to endeavor more clearly to understand our common cause. In China, thirteen years ago, it was the good fortune of some of us to serve with the allied forces before Tientsin. It was there that Captain Austin R. Davis, of the marines, a graduate of Annapolis, met a soldier's honorable death at the very front of our line. Upon that occasion we were joined in our advanced position with British troops—the Royal Welsh Fusileers, the famous "Twenty-third," whose history recites a heavy loss sustained at American hands more than a century ago at "Bunker Hill." Here, however, in the broiling hot sun, we British and Americans stood together in a common cause. We had been under constant fire for twelve long hours, when exhausted, without food or water, very short of ammunition, our dead and wounded about us, it became necessary that a report of our situation be communicated to General Dorward, British Army, our immediate commander, who was some distance in the rear of our advanced position. A captain of the Welsh called down the line for an orderly to be sent to him—a "nippy chap," he specified. A little Welshman—a Tommy Atkins—a smart soldier in his soldiering way—answered. He stood at attention, saluted—to him his duty was explained—he was to take the report to the general. That meant that he should cross, in broad daylight, a field fully covered by the

enemy's fire. Few of us expected him to succeed. He again saluted—repeated the message as it was given to him, showing that he understood it, then made a request, instantly granted, which struck me at the time as most singular—"May I choose me own way, sir?" he said. Tommy Atkins, in being so permitted to choose his own methods, fulfilled the higher purpose of his captain. That report reached the general; what we required came to us as the general's reply. Does anyone think that Tommy asked too much? We were not concerned with his methods; our sole desire lay in his success. So should it be with the matter in hand.

The "school" represented now by Commander Phelps, entrenched behind a masked breast-work, which we may properly style "the uplift of the bluejacket," most unsparingly criticised the marine in 1890—it most unjustly renewed its attack on him in 1896—the marine's answer to those attacks he made on the hills bordering Guantanamo Bay in the Spanish War in 1898. There a marine battalion, under command of officers of no Annapolis training, fine old soldiers whom we grateful graduates in the marines will never cease to honor or respect, seized and defended that "advanced base," without which the naval blockade in front of the Morro of Santiago, 40 miles distant, would never have been effective. The value of that marine to the naval service, the worth to the country of an officer without Annapolis training, was there most satisfactorily demonstrated. The policy of the Navy Department, in this matter under discussion, founded as it is upon the sentiments of the American people familiar with the marine's past services, represents the one way in which he is to be preserved to the navy. For those services the navy has never failed to receive the benefit as well as the credit; should the marine be transferred from the naval establishment, such action means a loss to the navy both in prestige and in power in peace and war. Here lies the dominant interest. Commander Phelps correctly says with respect to the Marine Corps: "The navy cannot do without it." If this so-called reform is to continue, as Commander Phelps says it must, it cannot fail to have its logical effect. The condition of unrest, the agitation produced throughout the entire naval service by these public discussions, cannot strengthen the bonds of affection as they now exist between us. These sentimental considerations that tie us together should not be destroyed. You may, if you will, properly uplift the bluejacket without humiliating the marine. For those who would be led to effort along these lines, it may be well to mention the admirable essays, one on "Trained Initiative and Unity of Action," by Lieutenant Commander Dudley W. Knox, in the March NAVAL INSTITUTE PROCEEDINGS; the other by Commander André M. Proctor, entitled "Organization of the Ship," in the June issue. Neither of those officers descends to attack the marine. Nor does the marine assail you. He desires nothing more than what, in your enlightened opinion, you decide to be necessary for your interests. In your hands, brothers of the line, rests the issue. You hold the power, you must bear the responsibility; you may meanly lose or wisely save to yourselves this Marine Corps. The folly related by Æsop in fables more than 2000 years ago is folly today. Do not drop the bone in the mouth to grasp at its shadow in the pool.

Twenty-eight years ago, on July 23, 1885, there died one of the most illustrious soldiers our country has produced. Our fleets received on North River, beneath the shadow of his tomb, the plaudits of the nation for our victories as against the ships of Spain. He was a man of great deeds but of few words. Having crushed at Appomattox the most formidable of opposition to federal authority, having vindicated by force of arms the policies of his government, he united in common interest the discordant elements of his people and endeared himself to his fellow-countrymen for all time by saying:

"Let us have peace."

Rapidity of Gun Fire.

(See No. 146, p. 699.)

LIEUTENANT (J. G.) GARRET L. SCHUYLER, U. S. Navy.—Discussion of any military subject, in the end, clears up details on which misunderstanding may exist, but the final conclusion is but a sort of weighted mean of the diverse views of the individuals, which views, as grounds for misunderstanding, are successively eliminated, arrange themselves even more markedly in two groups, the one favoring bold and the other cautious action. At the end each merely represents the mental type to which he belongs and from which it is purposeless to try to argue him.

The most mutable rate of fire is such a discussion, and those who would blaze away with utmost rapidity, at extreme range, cannot be reconciled with those who would with-hold their fire "till they see the whites of the enemy's eyes." Compromise, as a natural outgrowth, will inevitably follow without assistance from any one, but perhaps the basis for it may be elucidated.

In cases like these, it is, in general, helpful to assume the extremes, deduce the corresponding conclusions and interpolate between these in about the ratio suggested by the relative probabilities of the respective extremes.

As an example, analyze the suggestion that merit in gunnery be measured by "accuracy," *i. e.*, by percentage of hits alone. At first it seems ridiculous, but, on further thought, it appears the only method, if the engagement ends under circumstances which we will call supposition I, namely, that all ammunition is gone before (a) our last gun is disabled, or (b) our last target escapes, sinks or surrenders. "Accuracy" is the only proper way to score, if we fire all our ammunition, because its effect is dependent merely on how much of it hits. In putting no premium on economy of time, it represents one extreme.

"Hits per gun per minute" is so familiar that it is easy to overlook that it rests on supposition II, namely, ammunition remaining left over when the engagement ends by (a) our last gun being disabled, or (b) the last target escaping, sinking or surrendering It is the other extreme, in that it puts no premium on economy of ammunition.

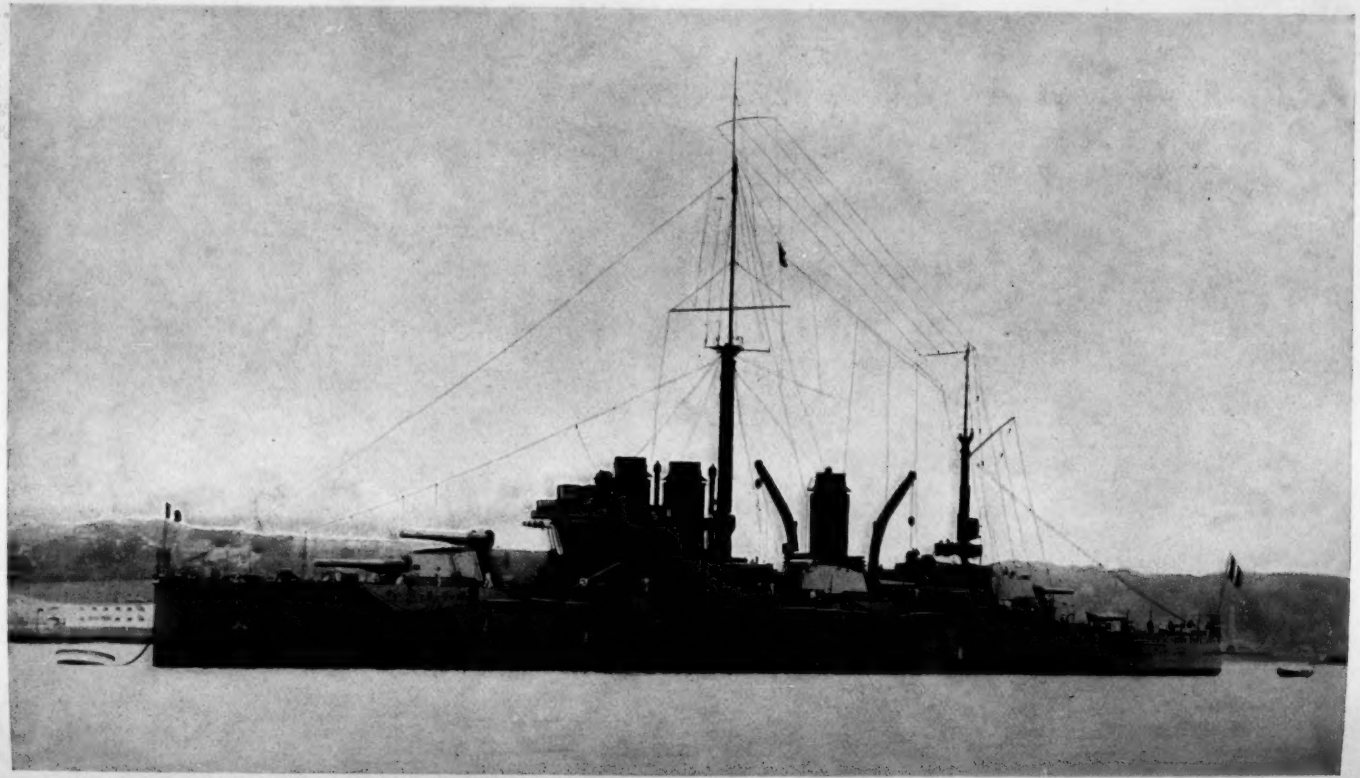
Supposition I leads to judging merit by "percentage of hits," supposition II to the "hits per gun per minute" formula. If we judge that in a

hundred instances supposition I will be true m times, and supposition II n times, the formula

$$\frac{m \times \text{"percentage of hits"} + n \times \text{"hits per gun per minute"}}{100}$$

looks logical. It only remains to get from the War College, or some other source, m and n, the percentages of instances where ships finished battles as in suppositions I and II.

This method may be helpful in simplifying the considerations leading to the adoption of the best compromise formula to encourage, in our target practice, the most appropriate balance between speed and accuracy.



"JEAN BART."

PROFESSIONAL NOTES.

Prepared by LIEUTENANT COMMANDER RALPH EARLE, U. S. Navy.

SHIPS OF WAR, BUDGETS AND PERSONNEL.

ARGENTINE REPUBLIC.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Rivadavia.....	28,000	22.5	12 12-in., 12 6-in.	Fore River Co.	Under trials
Moreno.....	28,000	22.5	same	New York Co.	Launched Sept. 28, 1911

"RIVADAVIA."—This vessel arrived at New York for docking the last week in July and ran her speed trials off Rockland during August.

OIL FUEL.—The Argentine Government have contracted with the Greenock & Grangemouth Dockyard Co., Greenock, for the construction of a tank steamer to carry 2600 tons of oil, to be built on the longitudinal system, and to be delivered in the early part of March. She is to be fitted with triple expansion engines to give a speed of eleven knots laden at sea, and will burn either oil or coal.

The Argentine Navy imports annually about 60,000 tons of coal, but this quantity is not sufficient for the consumption of the different dependencies and of the present fleet, thus preventing the desired extent being given the maneuvers of the force. The early incorporation into the fleet of two new battleships and four destroyers will make it obligatory to augment the supplies of coal, and 100,000 tons will be required. Therefore, the Minister of the Navy suggests the purchase of five colliers of 13,000 tons capacity which would cost 1,500,000 pesos each. These would bring to Argentina all the coal and other materials required by the public services and they would also take away cargoes of national produce which would yield to the state in freights £80,000 per annum. The Minister proposes that a special board should be formed for the administration of the special service of this fleet of transports. These transports would not, however, be required for the importation of coal if, as the Minister seems to think, the use of it can be substituted by that of petroleum.—*Shipping*, Illustrated.

AUSTRIA.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Tegetthoff.....	20,010	20	12 12-in., 12 5.9-in., 4 t. t.	Trieste	Commissioned
Prinz Eugen..	20,010	20	12 12-in., 12 5.9-in., 6 t. t.	"	Launched Nov. 30, 1912
Schwartzenb'g	20,010	20	10 13.5-in., 12 5.9-in., 6 t. t.	Fiume	Laid down Jan. 29, 1913
Ersatz Mon'ch	25,000	25	8 15-in., probably.	Trieste	Laid down May, 1913
" Budapest	25,000	25	same	"	To be laid down Dec., '14
" Wien....	25,000	25	same	Fiume	" " " " " '15

"TEGETTHOFF."—The trials of this vessel have gone ahead slowly. Her four-hour trial speed was 19.75 knots with 21,000 horse-power.

While heavy gun trials were going on on board the battleship *Tegetthoff*, the premature discharge of a 30.5-cm. gun in one of the after turrets caused damage to the deck near the ventilating funnels, and some steel supports were bent. The installations in two cabins were also damaged. The repairs will take from two to three weeks. She has now been commissioned.

THE "GIOVANNI-CORVINO-HUNYADI."—This is the fourth vessel of the *Viribus Unitis* class and has just been assigned the name of this fifteenth century hero of Hungary, who was the conqueror of the Turks.

FLEET NOTE.—The fleet has been put on the peace footing and all reserves ordered home. There are two battleship divisions, one cruiser division and a torpedo group retained in full commission.

BRAZIL.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleship					
Rio de Janeiro	27,500	22	14 12-in., 20 6-in.	Elswick	Launched Jan. 22, 1913

ARMORED RIVER MONITOR.—The armored river monitor *Javary*, built by Messrs. Vickers for the Government of Brazil, and recently launched—being the first vessel launched broadside at Barrow—is one of three in course of construction by this firm. The principal dimensions of the *Javary* are as follows: Length, 265 feet; breadth, 49 feet; depth, 8 feet 6 inches; with a displacement of about 1250 tons. The vessel has been designed for a speed of 11½ knots, and she will have an economical speed radius of 4000 nautical miles.

The *Javary* is primarily intended for river work, and is fitted with a double bottom extending almost the entire length of the vessel; stowage is provided between the double bottoms for feed water, oil fuel for the boilers, etc. This double bottom construction is continued up the sides of the ship to the upper deck in way of the engine and boiler spaces and magazines, adding to the safety of the ship. The hull, too, is separated into a large number of water-tight compartments by transverse and longitudinal bulkheads extending up to a complete steel upper deck. These compartments form the various store-rooms, magazines, bunkers, auxiliary machinery spaces, etc.

The armament, which is of the Vickers type, consists of two 6-inch Q. F. guns mounted in one armored turret on the upper deck forward and with electrical machinery for working the guns, two 4.7-inch Howitzers on the upper deck aft, four 4.7 mm. Q. F. guns on the boat-deck, and six R. C. guns on the boat-deck, and on the forward and after navigating bridges.

Two powerful searchlight projectors are fitted, one forward and one aft, and these are arranged to be controlled from a suitable position on the forward navigating bridge.

The sides of the vessel amidships for a very considerable part of the length of the hull are armored by heavy plating of the latest type, extending from the upper deck to well below the water-line. Forward and aft of this belt are armored bulkheads, extending the same distance below the water-line as the side armor. The remaining portion of the vessel's sides including the stern, are protected by thinner armor. The upper deck is of nickel-steel armor, forming protection to the various compartments.

In the heavily armored conning-tower are all appliances for working the guns, etc., and for controlling the vessel, and all communication wires, steering rods, etc., are placed within an armored communcation tube.

The magazines are ventilated and cooled on the thermotank system. Ice-making plant is also provided. For the cold storage of meat and perishable goods there is an insulated compartment fitted with brine grids.

A boat-deck is built above the upper deck forming a superstructure in which the officers are accommodated in spacious cabins fitted up in the usual manner. Pantries, lavatories, and wash-places are also built within this superstructure. On the boat-deck accommodation is provided in steel deck houses for the commander and navigating officer. The commander's apartments include a commodious reception room, and are handsomely decorated throughout. The complement is expected to be 100 officers and men.

Special attention has been given to both the natural and artificial ventilation of the vessel to give abundant supply of fresh air, in view of the extremely warm climate and great humidity of the atmosphere in the district in which the ship has to serve. The mechanical ventilation is carried out by means of ventilating fans worked by electric motor, and all habitable and semi-habitable spaces, such as the various store-rooms, etc., are provided with a very active circulation of fresh air. The whole of the living quarters, including even those situated above the upper deck, are provided with electric ventilators so as to maintain an efficient circulation of air.—*Naval and Military Record.*

SUBMARINE.—The submarine boat *F-1*, of the *Laurenti* type, was launched at Muggiano, June 11, by the Fiat San Giorgio Co., for the Brazilian Government. The dimensions are: Length, 150.9 feet; breadth, 13.5 feet; surface speed, 14 knots; submerged, 8½ knots. She will carry four torpedoes and two 450 mm. tubes.

TORPEDO-BOAT BASE.—The president of the republic has stated in a message to Parliament that it is his intention to establish a base for torpedo vessels at the mouth of the river Macacu which flows into the Bay of Rio Janeiro. The bed of the river for 2.5 miles has been dredged. The great advantage of this base is the fresh water. Brazil possesses 11 torpedo-boat destroyers of which 10 are modern and of 650 tons displacement and 28 knots, built in England in 1908 to 1910, and armed with two 4-inch guns, four 6-pounders and two 18-inch torpedo-tubes. There are also two boats of 130 to 150 tons displacement.

CHILE.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Almirante Cochrane	27,500	23	10 14-in., 22 5-in.	Elswick	Laid down Nov., 1911
Almirante Latorre	27,500	23	same	Vickers	" " Dec., 1911

THE NEW DESTROYERS.—The Chilean destroyer *Almirante Lynch*, the first of six similar vessels ordered from Messrs. J. Samuel White & Co., Ltd., East Cowes, by the Chilean Government, underwent her steam power trials on the Clyde at Skelmorlie, July 11. The length is 330 feet over-all,

and 320 feet on water-line; molded breadth, 32 feet 6 inches; molded depth, 21 feet; draft on trial, 9 feet 9 inches, at which she displaced 1530 tons. There are two 4-inch 40-caliber quick-firing guns abreast on the forecastle-deck. On a raised platform aft are two more 4-inch guns, arranged to fire over the forecastle-deck. Two 4-inch guns are placed abreast on the upper deck aft; four Maxim guns under the boats on the upper deck; two torpedo-tubes are provided. The propelling machinery, of the Parsons' impulse and reaction turbine type, is mounted on three propeller shafts, the designed power being 30,000. On the full-power trial this designed power was exceeded, and the guaranteed speed was thus easily maintained on the six runs over the measured mile, and on the six hours continuous trial. The mean speed on the measured mile was 31.7 knots, and on the six hours run 31.85 knots. Coal only was used on this trial. The boilers, of the White-Forster type, gave splendid results as regards coal consumption, absence of smoke and torching.

The coal consumption for 24 hours was 51 tons, giving 15 knots speed and a consequent radius of action of 3850 miles.

The vessels will have remarkable sea-going qualities, owing to the height and length of the forecastle, which is about 100 feet long.

A notable feature in the ship is the extensive radius of action provided for, while she is also fitted with both the Marconi and Telefunken systems of telegraphy. In her general equipment she is in advance of many vessels of the class. This applies to range-finders, navigating appliances, and boats, the latter including a motor-boat with a Mumford paraffin-motor, two whalers, two gigs, and one dinghy. Great care, too, has been devoted to the protection and insulation of the magazines, while the accommodation for the officers has had special consideration, not only in respect of its spaciousness, but its ventilation. There are two electric generators of a collective power of nearly 50 kw., and two refrigerating machines.

Mean over Six Hours Trial.

Speed	31.85 knots
Revolutions	612.5
Shaft horse-power	29,792
Mean coal per shaft horse-power per hour	1.85 lb.

At the time of trial the displacement of the vessel corresponded to that of her complete sea-going condition, with all armament, officers and crew, and stores, spare gear, and 200 tons of coal on board.

The *Almirante Condell* and *Almirante Simpson* are to follow immediately with their trials.

FRANCE.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Courbet	23,500	21	12 12-in., 22 5.5-in.	Lorient	Commissioned
Jean Bart	23,500	21	same	Brest	"
France	23,500	21	same	St. Nazaire	Launched Nov. 7, 1912
Paris	23,500	21	same	La Seyne	" Sept. 28, 1912
Bretagne	23,600	20	10 13.5-in., 22 5.5-in.	Brest	" April 21, 1913
Provence	23,600	20	same	Lorient	" April 20, 1913
Lorraine	23,600	20	same	St. Nazaire	Laid down Nov. 7, 1912
Languedoc	25,200	21	12 13.5-in., 24 5.5-in.	La Seyne	" " April 28, 1913
Normandie	25,200	21	same	St. Nazaire	same
Flandre	25,200	21	same	Brest	To be laid down Oct. 1, '13
Gascogne	25,200	21	same	Lorient	same

"LANGUEDOC."—The second dreadnought of the 1913 program, was commenced at the Chantieres et Atelieres de la Gironde, Bordeaux, on April 28 last. Her principal dimensions are the following: Length, 574 feet; breadth, 88 feet 7 inches; draft, 28 feet 5 inches; displacement, 25,230 tons. The armament is to consist of twelve 13.386-inch guns, mounted in three quadruple axial turrets; twenty-four 5.512-inch guns; four 1.850-inch guns; and six under-water torpedo-launching tubes. The belt armor is to be 12.598 inches thick at the center. The *Languedoc* will be propelled by two reciprocating engines driving the wing shafts, and two Schneider-Zoelly turbine sets driving the inner shafts. The contract speed is 21 knots. A plan and elevation of this class was shown on page 841 of last issue.

"JEAN BART" AND "COURBET."—The illustrations, reproduced herewith from the *Engineer*, of the dreadnought *Courbet* are interesting in several particulars. The large openings in front of the turret for sights are not in accordance with modern ordnance practice. The method of securing the turrets for sea appears unusually large and unwieldly. The large port openings indicate trunnions are placed rather far from port plate. The turret appears, however, to cover the barbette at all portions of train. The battery of three 5.5-inch guns is a good shell exploder judging from the light armor and the overhang. The shields for these guns have extraordinary openings for sights, omission of shields altogether would probably be better practice.

Their leading particulars are as follows:

Length on the water-line	541 ft. 4 in.
Beam	88 ft. 6 in.
Maximum draft	29 ft. 6 in.
Normal displacement	23,467 tons
Designed horse-power	28,000
Designed speed	21 knots

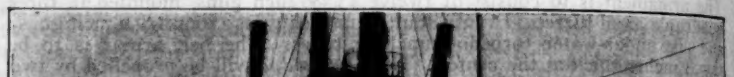
The propelling machinery consists of combined impulse and reaction turbines of the Parsons' type, and the vessel is fitted with Belleville boilers in the *Jean Bart* and with Niclausse boilers in the *Courbet*, arranged for burning coal or oil. Their maximum fuel capacity is 2700 tons of coal and 1000 tons of oil, which is calculated to give her a nominal radius of action of 8400 miles at 10 knots and 2300 miles at 20 knots.

The main armament consists of ten 12-inch guns housed in pairs in five turrets, these being controlled on the Janney electro-hydraulic system. The thickness of the turret armor plating is 10 inches. The guns have been designed to fire one shot each twenty-five seconds. The heights of the guns above the water-line varies from 21 feet 5 inches to 30 feet 7 inches, and their arcs of fire from 135 degrees to 180 degrees. Each gun is about 59 feet in length and weighs 55 tons. The shells fired are about 4 feet in length and weigh 970 pounds. One hundred shells per gun are carried.

The secondary armament consists of twenty-two 5½-inch quick-firers. These are arranged in ten sections. There are two sections of three guns, one on each side of the citadel, while the remaining guns are arranged in pairs in casemates. The arc of fire of all these guns is 120 degrees. The guns in the citadel are 18 feet 6 inches above the water-line and other guns 12 feet above the same level. The shells each weigh 80 pounds and 275 rounds per gun are carried. The shells are taken up to the casements by electrically driven hoists which are designed to deliver fifteen shells per minute. There are also four 47-mm. 1.46-inch guns, and four submerged torpedo-tubes. Two of these are arranged forward and two aft. They are of the 1909 design, and are for discharging 18-inch torpedoes. Twelve torpedoes will be carried. Forty Sauter-Harlé submarine mines will also be carried.

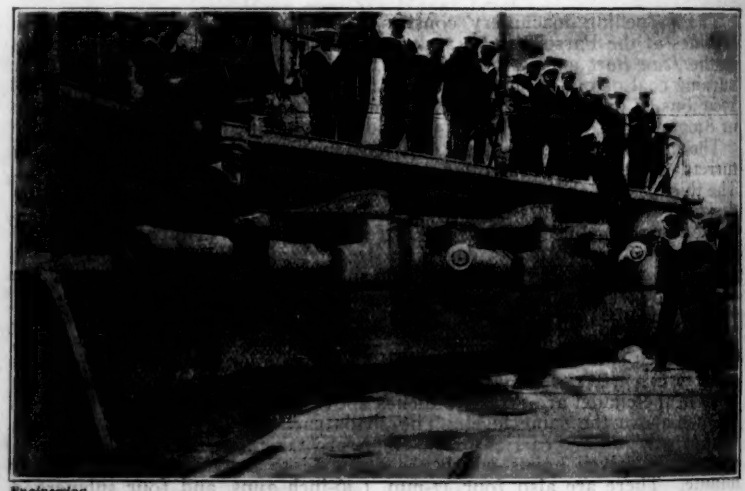
The armor belt for a length of 214 feet amidships is 9⅞ inches thick. At the two ends this thickness is reduced to 6⅓ inches. The total depth

of the belt is 13 feet 3 inches, of which 7 feet 8 inches are above the water-line. The citadel is 197 feet in length, and is protected with 7-inch armor plate, which extends down for two decks. Both ends of the citadel are closed by transverse bulkheads of the same thickness. There are two pro-



Engineering

QUARTER-DECK (FRENCH BATTLESHIP "COURBET").



Engineering

BATTLESHIP "COURBET"—THREE 5.5-INCH GUNS.

tective decks. The lower of these is 5 feet 7 inches below the water-line, and is composed of 2-inch plating on the flat and 3-inch plating on the slopes. The upper protective deck joins the upper edge of the main armor belt and is composed of 1 13/16-inch plates. This thickness of plating is also employed above the citadel, and for the after casements.

The hull below the lower protective deck is divided into numerous watertight compartments. None of the main compartments are pierced for doorways. For example, there are no doorways cut in the engine-room bulkheads. The space between the two protective decks is divided into numerous cofferdams and compartments.

The conning-tower is protected with plating having a maximum thickness of 12 inches. It is divided into three compartments and access to it is obtained by one door only.

The rudder is of cast steel. It can be operated either by steam, electricity or by hand. It is of the balanced type, and can be turned through an angle of 32 degrees on each side. There are three anchors. Two of these weigh 9 tons each. The third is of the Morel type. All are provided with 3-inch chains. There are two steel masts which rise to a height of 105 feet above the water-line. The foremast is provided with a timber mast 197 feet high and the main mast with a timber mast 115 feet high, these being used for signalling purposes and for wireless telegraphy. The boat equipment is as follows: Two 33-foot 3-inch steam launches, three 36-foot motor launches, one 36-foot boat, two 34-foot 6-inch boats, four whale boats, etc.

There are six 200-kilowatt steam dynamos, each driven by a high-speed reciprocating engine. These supply current for power purposes—steering, turret working, sheel hoisting, etc.—for lighting and for ten searchlights, eight of which are 35 inches in diameter and two of 30 inches. There are two refrigerating engines and thirteen air coolers. The ammunition rooms are insulated with cork, asbestos, etc. The smokeless powder rooms are quite distinct from the black powder rooms, the shell rooms and the gun-cotton rooms.

The following are the results of the official trials of the *Jean Bart:*

Ten Hours Full-speed Trial.

Date	April 29, 1913
Number of boilers at work	24
Steam pressure	252 lb. per sq. in.
Revolutions, mean	285
Speed on measured mile, mean	21.16 knots
Speed for 10 hours, mean	21.09 knots
Consumption of coal per mile, as specified	2645 lb.
Consumption of coal per mile, actual	2449 lb.

Three Hours Full-speed Trial with Forced Draft.

Date	May 5
Number of boilers under steam	24
Steam pressure	252 lb. per sq. in.
Revolutions	305
Shaft horse-power	42,000
Mean speed	22.04 knots
Best run on measured mile	22.63 knots
Coal consumption, as per contract, for 20 knots per square foot of grate area	32.77 lb.
Ditto, ditto, on actual trial	30.11 lb.
Ditto, ditto, at 22.04 knots	33.18 lb.
Coal per horse-power, as specified	1.87 lb.
Coal per horse-power, actual	1.7 lb.
Coal per mile run	3167 lb.
Air pressure	1.03 in.

Twenty-four Hours Consumption and Endurance Trials.

Date	May 9 and 10
Number of boilers under steam	24
Revolutions	240
Mean speed	18.57 knots.
Coal consumption per mile, as specified	1840 lb.
Coal consumption per mile, actual	1611 lb.

Consumption Trial at Cruising Speed.

Date	May 15
Number of boilers under steam	24
Mean speed	12.81 knots
Coal consumption per mile, as specified	1080 lb.
Coal consumption per mile, actual	937 lb.

The *Courbet,* however, did not come out so well. The *Naval and Military Record* says:

Great interest attached to the comparative trials of the *Courbet* (24 Niclausses) and *Bart* (24 Bellevilles) in view of the very unequal results obtained with these rival types of large tube boilers in ships of previous series. It was sincerely hoped, specially on the part of naval men concerned with the rather inferior utilization of the engine power in the French Navy, that the Niclausses would this time meet with better luck and compete on equal terms with the Bellevilles. These expectations have, unfortunately not been realized. The *Courbet,* though she attained her designed speed, has proved inferior to her sister ship. Whereas the latter went through the steaming tests without a hitch and in record time, realizing over 22 knots for 3 hours and 21.16 knots for 10 hours, the *Courbet* could not exceed 20.637 knots during her 3 hours trial, whilst in her 24-hour endurance test, with ¾ boiler power (22,000 horse-power), she only maintained 17.9 knots. Even taking into account the dirty condition of the hull, this performance can hardly be said to be satisfactory, when it is remembered that the 23,000 ton British *Orions* easily maintained 19 knots for 30 hours with only about 19,000 horse-power.

DESTROYER "MAGON" AND CLASS.—On April 19 the French torpedo-boat destroyer *Magon* was launched from the slips of the Ateliers et Chantiers de Bretagne, at Nantes. She belongs to the new class of 800-ton vessels which have been designated "fleet destroyers," and will be, when she is completed, a particularly fine boat. Her stern is shaped not unlike that of a racing motor boat, while she has a high freeboard forward so as to allow her to keep her speed in rough weather.

The main particulars of this destroyer are as follows: Displacement on trials, 787 tons; displacement with extra bunkers full, 850 tons; length over-all, 272 feet 4 inches; breadth, 27 feet; depth, 16 feet 5 inches; draft astern, 10 feet.

The hull, which is of Siemens steel, is divided into eleven water-tight compartments. The shell plating has a tensile strength of 38 tons per square inch, with a reduction in area of 16 per cent. The stern is of forged steel, while the stern post, stern brackets, and rudder are of cast steel. The eleven compartments are allotted as follows: The first forward is the collision compartment, then come the chain lockers and store compartments, and then the crew's quarters. Aft of these come two independent boiler-rooms, and then two independent engine-rooms. Aft of these, again, are the officers' quarters, the petty officers' quarters, and the ammunition and store-rooms.

There are to be four water-tube boilers of the du Temple type, which supply steam for the main propelling engines and the auxiliaries. The working pressure is 228 pounds per square inch. They are fired with oil fuel burnt by du Temple burners. The liquid fuel tanks have a capacity of 1300 cubic feet.

The main engines are to be of the Rateau-Chantiers de Bretagne type. There are to be four turbines, two for ahead and two for astern working, and they are to drive two propellers 7 feet 2 inches in diameter.

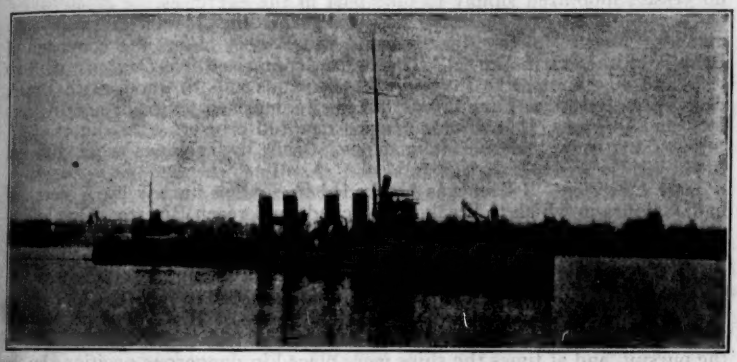
According to all accounts, this motive power gives good results in destroyers, while, if rumor is to be believed, it is shortly to be employed for warships of far larger displacement and requiring much greater power than destroyers. The particular turbines in question are designed to give 18,000

shaft horse-power. The contract speed is 30 knots, but a speed of 34 knots is confidently expected.

Two electric sets of 13 kilowatts each, driven by internal combustion engines, are to supply current at 80 volts for general lighting and for a 24-inch searchlight.

The armament is to consist of four 65-mm. guns on the quarters and one 4-inch gun forward and one aft. Two hundred and fifty shells will be carried for the 4-inch guns and 346 shells for the 65-mm. guns. There will be four 18-inch torpedo-tubes, arranged aft in pairs. Six torpedoes will be carried. The complement will be six officers and seventy-five petty officers and men.—*The Engineer.*

There are fourteen vessels in this class. On the preliminary trials the *Foulx* attained a mean speed of 33.374 knots, but the results of the official trials were not as good because of the high sea running, the foul bottom of the destroyer. The *Voltigeur,* the *Fourche* and the *Foulz* of this class are now in service.



FRENCH FLEET DESTROYER "FOURCHE."

NAMES OF SUBMARINES.—There are to be two series of names. The vessels called by the names of noted men are all to be fitted with steam engines, those called by the names of famous old vessels are fitted with Diesel motors. The first in the steam engine series is the *Gustave Zédé,* the last two in the Diesel motor series are the *Clorinde* and the *Cornelie.*

THE "GUSTAVE ZÉDÉ."—This large vessel was launched at Cherbourg in the latter part of May. It is 235 feet long, 20.6 feet wide, displacing on surface 800 tons and submerged 1050 tons. There are six movable and two fixed torpedo-tubes. For motive power on the surface two steam engines of 1500 horse-power each with four du Temple boilers are supplied. For submerged work there are two 1500 horse-power electric motors. The speed is to be 12 knots submerged and 18 knots on the surface. At first it was planned to fit Diesel motors to the *Zédé,* but the unsatisfactory experiences with these wisely caused a return to steam engines. In order that they may be the more easily hauled up in case of disaster, French submarines are now being fitted with rings. The *Gustave Zédé,* the largest French submarine, has no fewer than 18 attached.

COALING.—An innovation of the maneuvers was the exclusive use of Welsh coal instead of the inferior French substitute, with, as a consequence, the suppression of the huge clouds of black smoke that have so long been a special feature of the Gallic fleet at sea, in addition to a more economical production of steam. Some progress is also to be noted in the coaling per-

formances. The *Diderot* shipped 650 tons in five hours, an average of 130 tons per hour.

TARGET.—A pontoon for carrying targets used in gunnery training by the Toulon squadron of the French Navy, has been constructed at Marseilles. This pontoon is said to be the largest of its type afloat, being 196.8 feet long, 7 feet wide and 13 feet draft. The concrete false keel weighs 32 tons and the total weight is 200 tons. The pontoon is made of solid timbers bolted together and strengthened by iron bands. The ends were fined by cutting into the timbers.

THE MANEUVERS.—The period of these maneuvers in the Mediterranean was from May 19 to June 13. These were the most important ever carried out by the French fleet, the vessels engaged having been those of the active fleet that have been under the skilful training of Vice-Admiral Boué de Lapeyrére and thus formed a quick maneuvering reliable force. There were no vessels mobilized simply to take part in the exercises.

Forces.—Sixty-two vessels were divided into the A fleet under the command of Rear Admiral Marolles, and the B fleet under the command of Rear Admiral Marin-Darbel. The A fleet comprised five *Dantons* of 18,000 tons and 19.5 knots, five *Patries* of 15,000 tons and 19 knots, with sixteen destroyers and three mine layers. B fleet comprised six *Suffrens* of 12,000 tons and 15 knots, four *Victor Hugos* armored cruisers of 23 knots speed, thirty destroyers and five submarines. Nine hydroplanes were attached to the fleet.

First Exercise.—B fleet was blockaded in Toulon harbor by A fleet and had 48 hours in which to break the blockade and reach Bizerta. One hydroplane out of two used by B was successful in making a flight of 60 miles and located the A's. B's submarines then torpedoed two battleships of A's force. A was thus compelled to withdraw his vessels to a greater distance. This enabled B to escape from Toulon molested only by A's torpedo vessels which being inferior in strength to those of B's retired.

A (ten battleships of 18-19 knots sea speed) was much handicapped in the pursuit, and at times the ships were placed in dangerous positions by the repeated breakdown of the units of the *Danton* class, which appear to have engines more fragile than those of their predecessors of the *Patrie* series. Whereas the latter maintained without difficulty a speed of over 17 knots across the Middle Sea from Toulon to the Tunisian coast, the *Condorcet*, *Vergniaud* and *Mirabeau* had successively to reduce speed from 18 to 16, and even 12 knots, to try and make good some defects, with the result that the paper speed of the Première Escadre (superior by three or four knots to B) proved of little avail to Admiral de Marolles (A). The breakdown of the *Condorcet* was especially unfortunate, and might easily, in real warfare, have entailed disastrous consequences, as it occurred when the *Danton* and *Condorcet*, then far from the other vessels of their party, were engaged in hot pursuit with every hope of keeping in touch with B, and left them exposed to the full concentration of the enemy, which would have meant for them either capture or destruction. Happily, Admiral Marin-Darbel (B), unaware of the plight of the *Condorcet* (which had slackened down to 12 knots), did not turn back, and pursued his route towards Bizerta, his obsolete battleships (*Charlemagnes-Jaureguiberrys*, 1895-93) maintaining 14-16.5 knots.

These much commented upon incidents show once more that the real speed of ships has more to do with the conditions of the engines and the professional competence of the engine-room complement than with the designed or the trial speed figures, and have created an impression all the more disagreeable, as the newest and most powerful of the "cuirassés" (the 18,000-ton *Dantons*) in service are found to be the least reliable.

Second Exercise.—A was to prevent B, now at sea, from entering Bizerta. B attempted to engage separately the first and second squadrons of A based

on *Ajaccio* and *Phillippeville* respectively, but failed, and the two fleets met during the night off the Tunisian coast. In the darkness it was difficult to tell friend from foe, and though to A is accorded the victory, the result of the battle was really in doubt.

Third Exercise.—B fleet, under Rear Admiral Sugny, attempted to prevent the junction of two inferior fleets, one off Algeria and the other off Corsica. A fleet, under Rear Admiral Gauchet, due to its greater speed, effected the junction, and B received an order to engage A. The battle opened at 6000 yards range and closed with a dash of torpedo-boats.

Fourth Exercise.—After a review by President Ponicaré tactical exercises to enable senior officers to gain experience in the handling and maneuvering of ships in company took place. When the first squadron was at 9600 yards from the enemy instead of profiting by its heavy artillery to crush them it continued to close, though deluged the while with the fire of the enemy. When the squadrons were distant 5500 yards Rear Admiral Marolles crossed the T. Vice Admiral Lapeyrère then maneuvered to break the T, but by rights he would have been beaten before this.

M. Charles Bos in *La Vie Maritime* criticizes the commander-in-chief, adversely stating that he limited the initiative of his division commanders because he desired all the authority himself. The result of this interference was to destroy the interest in the maneuvers. The destroyer commanders found they had to fight day and night, then scout, and do despatch duty till they could do no more. It is necessary to take cognizance of the endurance of the crews and matériel. Our service has not the proper types of ships, lacking scouts, battle-cruisers and fast battleships. The use of destroyers as scouts has been condemned by everyone for years.

M. C. Pierceval in the *Moniteur de la Flotte* in analyzing the maneuvers has somewhat as follows to say:

The blockade of Toulon carries a moral. We do not strive our utmost in drills as in war, we play with some hazards that we would not run if they were real, such as submarines, and we avoid others that we would take without a thought if they had a possible success, such as night torpedo attacks. The mind works in a different groove and it is impossible for a person to change that. From the preceding we see that the lessons therefrom are very relative. They are not negligible, because in a critical discussion there are points that can be made with truth. So the blockaders, in fixing their line during the day at less than thirty miles from the passes of Toulon neglected the risks they would run from enemy submarines. They wished at all costs to witness the sortie. At night they steamed further out; thus showing great regard for the torpedo vessels and preferring to have plenty of sea room in order to escape them; at this time the requirement of holding the enemy was weakened. In war, however, the objective will not change with the course of the sun and there is or is not always the same necessity for the blockade. Either Admiral Marolles was wrong in the day or wrong in the night, he was not correct at both times. And the lesson is that one must stick to his "mission" at all costs. The first day of the blockade was marked by a show of fear of unloaded guns that would nexer exist in the case of loaded ones. Yet the submarines, destroyers and cruisers navigated with such an utter disregard of danger that in reality at the end of two days of the blockade there would not have remained afloat a single vessel of the contestants. It indicates nothing that the blockade was forced, but it indicates much that whatever the blockaded squadron had done, or whatever course they had taken to escape to sea they would have encountered only the empty sea or small units of the blockaders, too weak to fight and too scattered to aid one another. Too great value was placed on their advantage of speed by the blockaders and this led them to take positions which were bound to result in the success of the blockaded. "That is the good and undisputed lesson."

The estimate of the advantage gained by superiority in speed in action is certainly one of the most difficult to exploit as well as most dangerous to handle. Speed is an essentially fragile thing and our estimate of it should be prudent. One thought that if the squadron forced the blockade its cruisers would have cleared the passages of the curtain of destroyers. Actually, though the destroyers were at their posts, they were not seen. Meanwhile during the day the cruisers had destroyed the fourth flotilla. The conclusion that the success of the blockaded was due to the cruisers is premature and only based on the fact that they would have weakened and put the screen of destroyers in confusion. In any event, the absence of fast ships was scarcely felt by the blockaded. During the exercises little use was made of fast cruisers, and the lesson learned was that the strategical victory belongs to the side that places on its scouting line a force strong and swift enough to drive back or sink the enemy's scouts while perfectly supporting its own. The work of the submarines was very remarkable. They inflicted serious losses on the blockaders at Toulon, they proved at Bonifacio that a strait guarded by them cannot be passed, and they even showed that they have an important rôle on the high sea. The blockaders at Toulon felt the absence of torpedo-nets severely, they needed protection of this sort. Our new battleships are to have Bullivant nets, but would it not be wise to equip our older ones also? It is necessary to have battle exercises at night that are not limited to attacks by torpedo vessels.

As a result of the maneuvers a strong plea for fast scouts presumably similar to the English light cruisers is being made by the French Admiralty and it is very probable that the scouting forces will be materially added to in this year's budget.

The Naval and Military Record says on this point:

Another result of the maneuvers has been to demonstrate the need of scouts, and the great inferiority of an admiral who would lack light cruisers to shadow the enemy and hunt down hostile flotillas. And yet such was the position of Admiral de Marolles (A) when he tried to blockade Toulon with ten battleships and a dozen small destroyers, and, later, to locate his opponent in the wide expanse of the Mediterranean. He failed, and was, of course, attempting an impossible task. This absence of scouts made the French admirals very much in the position of blind men feeling one for the other, and left too great a place to chance in the operations. Torpedo-boat destroyers of 400 and 700 tons were substituted for cruisers, but proved unequal to the strain; several broke down, and most of them would in actual warfare have fallen an easy prey to hostile scouts. As to the 12,570-14,000 tons *Croiseurs Cuirassés* (with the B party), they are judged to be both too large and too slow (23-25 knots on paper, but 21-22 knots at sea) for reconnoitring duties. Hence the unanimous demand for the prompt laying down of the projected scout-cruisers of 6500 tons and 27 knots speed.

THE NORTHERN MANEUVERS.—A demonstration has just been made of the vulnerability of the Cherbourg point d'appui, and of the powerlessness of flotillas, even numerous and efficient, to prevent, under the conditions of weather often prevailing in the Channel, the success of a skilfully conducted landing operation against the Norman coast. This serves to confirm the lessons of previous maneuvers, and at the same time strengthens the case of the partisans of an adequate supplementary program. On the night of July 11 Rear-Admiral Favereau, despite the inferior means of action he had in hand (a few cruisers and some 20 destroyers), managed, after making a series of false attacks on various points of the coast, to effect a landing in Vauville Bay, and also to seize the Marcouf Islands, without meeting with any hindrance on the part of the 40 torpedo-boats and submarines of the Cherbourg flotilla, which were handicapped by foggy weather in their search for the blockaders. This interesting exercise, which reflects credit on the

resourcefulness of the commanding admiral, is held as a further proof that Cherbourg and the Northern coasts are at the mercy of the German fleet, and it has created all the more sensation as, strange to say, a well-planned port is being constructed at Dielette, in Vauville Bay, by German labor and under German management, for the exploitation of neighboring mines. Another lesson of the recent maneuvers was to show that the difficulties attending the effective blockade of the Brest roadstead are far from being as great as is sometimes claimed, despite the advent of the submarine factor.

GERMANY.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Kaiserin	24,500	21	10 12-in., 14 5.9-in., 4 t. t.	Kiel (Howaldt)	Commissioned
Prince Regent Leopold	24,500	21	same	Germania Works	Under trials off Danzig
König Albert	24,500	21	same	Danzig (Schichau)	Commissioned
Grosser Kurfuerst	27,000	23	same	Hamburg	Launched May 5, 1913
Markgraf	27,000	23	same	Bremen	" June 4, 1913
König	27,000	23	same	Wilhelmshaven	" Mar. 1, 1913
Ersatz Brandenburg	27,000	23	same	Germania	Laid down Dec., 1912
Ersatz Worth	.....	..	8 15-in., 16 5.9-in.	Kiel	Laid down July, 1913
"T" 1913	.....	..	same	"	.....
Cruisers of the Line					
Seydlitz	25,000	27	10 11-in., 12 6-in.	Hamburg	Commissioned
Derfflinger	28,000	27	8 12-in., 14 6-in.	"	Launched July 1, 1913
Ersatz Kaiserin Augusta	28,000	30	same	Dantzig	Laid down Sept., 1912
Ersatz Hertha	.....	..	....	Wilhelmshaven	Laid down July, 1913
Protected Cruisers					
Karlsruhe	4,900	28	12 4.1-in., 2 t. t.	Germania	Under trials
Rostock	4,900	28	same	Howaldt	same
Ersatz Irene	4,900	27	10 6-in.	Bremen	Laid down
" P. Wilhelm	4,900	27	same	Kiel (Kaiserliche)	" " Oct. 23, 1912

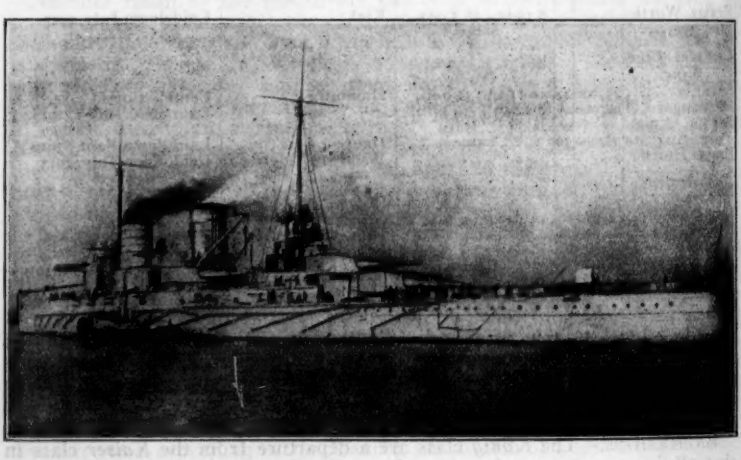
NOTE.—In this table of vessels it will be noted that the armaments of several vessels have been changed from last issue. Errors unavoidably occur, but the present table accords with the data recently given in *Marine Rundschau* and *Nauticus*.

BATTLESHIPS.—The *König* class are a departure from the *Kaiser* class in that all five turrets are placed on the center line and in the fact of having more speed. The 14-inch guns they were reported to carry do not exist and Germany has jumped from the 12-inch caliber to the 15-inch. The *Ersatz Worth* and *T* are the first to be thus armed and have four double turrets on the center line. The table on page 845, PROCEEDINGS, June, 1913, No. 146, is correct with the exception of the armament of the *König* which should be the same as that of the *Kaiser*.

"KAISERIN."—This vessel made 23.8 knots on her speed trials on the Neukrug measured mile off Danzig.

"DERFFLINGER."—After two futile attempts on June 14 and June 19 this vessel was launched on July 1, 1913. The reason assigned for these two failures in attempts to launch the *Derfflinger* is that the lubricant used between the sliding surfaces had either become quite dry or had melted entirely away, due to the unusually high temperature experienced at the time.

CRITICISM OF BATTLESHIPS.—As a result of the official publication of details respecting the armament of new battleships and cruisers, a heated controversy has arisen between the naval experts of three Berlin papers. An article by Captain Persius, entitled "The Inadequate Armament of our Battleships," which appeared in the Berlin *Tageblatt* on July 10, ushered in this acrimonious discussion. This authority expresses the bitter disappointment which is understood to prevail in some circles at the feeble gun-power of all the battleships now in hand when compared with contemporary vessels in England, France, and the United States. He charges the Navy Department with ultra-conservatism in this as in other scarcely less important branches of technical development, and he cites numerous authorities, including several German naval officers, who had previously complained that the capital ships produced in Germany since the dreadnought era are inferior in hitting power to foreign ships of equal date. Few observers in England will question the force of this criticism, but it has nevertheless called forth angry protests from the *Kreuz-Zeitung* and from Count Reventlow in the *Tages-Zeitung*, both of which journals seek to show that all the German dreadnoughts built up to date and now in hand, far from being inferior, are in every respect superior to their British contemporaries. This is a bold claim to put forward, and it is not surprising to find it unsupported by any real evidence.—*Naval and Military Record.*



BATTLE CRUISER "SEYDLITZ."

"SEYDLITZ."—This vessel is a sister ship of the *Goeben* and *Moltke*, differing slightly, however, in being 45 feet longer, 3 feet narrower, with thicker armor and having more freeboard. Dimensions are: Length, 656 feet; beam, 93 feet; displacement, 25,000 tons; designed speed, 26.5 knots, with 63,000 I. H. P. There are Parsons' turbines, four screws, and 27 boilers. Coal capacity is 3600 tons. Complement is 1108 officers and men.

On a trip from Danzig to Kiel this cruiser developed 100,000 I. H. P. On July 18 she made a speed of 29 knots.

A REMARKABLE EXHIBITION OF ESPRIT DE CORPS BY THE CREW OF THE "SEYDLITZ."—This cruiser was suddenly recalled from Danzig on June 28 by a wireless message from the Emperor at Kiel, and arrived at the latter port on the following day. As she had coaled no less than three times during the week, she arrived in Kiel harbor literally covered with coal dust and grime. Immediately she was moored it was announced that the Emperor would pay a visit of inspection next morning (June 30). The ship was cleaned up as far as was possible at such short notice, but in view of the excessive strain which the crew had undergone the commanding officer decided to postpone the furbishing of metal work, etc., until after the Imperial visit, knowing that the Emperor would readily understand the exceptional circumstances. The order was therefore given to cease operations, and the men were told to turn in for a good night's rest. The men, however, were determined that their ship should make a worthy appearance when the Emperor came aboard. Consequently they all turned out several hours before daylight, without orders be it said, and set to work with a will. An hour before the visit the ship was as smart as a new pin. When his Majesty arrived and heard of the strenuous coaling operations of the previous week he is said to have been astounded at the spick-and-span appearance of the cruiser. The crew mustered and treated to a warm speech of appreciation by the Emperor. This incident deserves to be recorded as an evidence of the spirit which prevails among the lower-deck ratings of the Germany Navy.—*Naval and Military Record.*

SCOUT-CRUISERS.—The figures of the speed of these vessels previously given in the PROCEEDINGS is confirmed and is repeated herewith:

Six Hours Full-power Trial.

	Mean speed.		Maximum speed.	
	kts.	*s.h.p.*	*kts.*	*s.h.p.*
Magdeburg.....	26.9	25,136	27.614	29,904
Breslau.....	27.2	28,872	27.552	33,482
Stralsund.....	26.957	27,032	28.277	35,515
Strassburg.....	26.9	25,647	28.28	33,742

The *Strassburg*, which thus proved the fastest of the four, is equipped with Parsons' turbines, the *Breslau* having A. E. G., and the *Magdeburg* and *Stralsund* Bergmann-Tosi turbines.

GERMAN DESTROYERS.—Several of the new Vulkan destroyers (of the series *V 1* to *V 6*) are now running speed trials in the Baltic, and in every case the contract speed of 32.5 knots is said to have been exceeded. In this class the forecastle is slighter higher than in earlier boats, adding to their weatherliness, the bridge being placed further aft. This arrangement should facilitate watchkeeping duty in heavy weather, as the occupants of the bridge will escape some of the spray which breaks in clouds over the low foredeck and advanced bridge of many an older foreign destroyer.

The secret of Germany's success with the high-sea torpedo-boat or destroyer is to be found in the fact that she has always paid as much attention to those constructional features which make all the difference between good and bad behavior in a heavy sea as to mere speed, whereas in many other countries the average destroyer hitherto has been eminently suitable for smooth-water work, but is almost helpless in a seaway.

STRENGTH OF THE TORPEDO FLEET.—Some figures recently published by the Navy Department show the imposing strength of the German Mosquito fleet. The present torpedo establishment is put at 225 surface boats, of which 145 are classed as "large" torpedo-boats, *i. e.*, destroyers with modern equipment and able to operate on the high sea. These 145 vessels are grouped in twelve flotillas, to which belong all the boats from *S 90* down

to the latest turbine-driven destroyers. Of "small boats," there are 24, with an average displacement of 160 tons and a speed of 25 knots. These are mostly in reserve, but all are kept in good order, and are quite serviceable for minor operations. Thirty-four further small boats are doing duty as mine-layers and sweepers, and twelve others as tenders to the High Sea fleet and torpedo school. Finally there are eight division boats, averaging 350 tons and 24 knots, which were built for the special purpose of acting as leaders to flotillas of smaller craft. This duty has since been assumed by cruisers in practically every navy. Several of the very old 17-knot boats are being used up as targets.—*Naval and Military Record.*

SPEED RUNS.—*S 22*, one of the twelve *Schichau* destroyers of 1912 program, made off Pillau a mean of 34.18 knots for three hours with a maximum of 35.91 knots.

Submarine *U 21* made 21 knots on the surface. She is 213 feet long and 20 feet wide.

FAST COALING.—During the last twelve months the *Helgoland* has maintained her reputation of being the smartest ship in the fleet at coaling. Recently she broke all records by taking on board 756 tons of coal in one hour, earning thereby a special message of congratulation from the Emperor. The nearest approach to this figure was made by the *Ostfriesland* last year with 722 tons for the best hour. This year the *Schleswig-Holstein* takes second place, but details of her performance have not yet been published.

PERSONNEL.—The present strength of the German naval personnel is as follows: Seaman division, 25,471; dockyard division, 21,764; torpedo division, 10,041; submarine division, 764; mining divison, 1087; marine artillery (for coast defences), 4102; boys (for long service), 1950; marine infantry, 1292; aeronautical division, 199. The officers number 3394.

Recruiting is stated to be very satisfactory, voluntary enlistments being more numerous each year.

The Navy League meeting at Bremen on May 25 was attended largely and counts 337,000 members. It was voted to work for a flying battle squadron and light fast cruisers.

MANEUVERS.—The spring maneuvers took place between May 5 and 26. Practically nothing has been made public relative to them. The combined High Sea fleet, under the command of Vice Admiral von Ingenohl, consists of five battleship divisions, two cruiser squadrons, four destroyer flotillas, and a division of submarines. The *Friedrich der Grosse* is acting as fleet flagship. Ten dreadnought battleships and two battle-cruisers are included in this huge force, but the cruiser squadrons are considerably below strength owing to the absence of four ships, including the *Goeben*, in Levantine waters. The present fleet is the strongest that Germany has ever assembled for maneuvers. Its aggregate tonnage exceeds 350,000, and something like 27,000 men are in the ships. Apart from the commander-in-chief, nine flag officers are present at the exercises. The large number of mine-layers and sweepers which accompany the fleet indicates that mine work is to be an important feature. On the other hand, the destroyers and submarines are not so numerously represented as on former occasions.

Some secrecy surrounds the venue of the maneuvers, but it is known that for most of the time the ships will be in the North Sea, and that the island of Sylt constitutes the base of one of the squadrons. Torpedo and mining work is expected to be much in evidence in the neighborhood of Emden and Borkum, and Heligoland is one of the bases for the waterplanes, about six of which machines have been detailed to the fleet as scouts.

The summer maneuvers commenced the night of July 16 with the departure of the second squadron from Kiel, the cruisers leaving the follow-

ing day. The exercises are to continue until August 16, the vessels coaling and provisioning on the coasts of Norway under war conditions.

ACCIDENTS.—The new battleship *König Albert* grounded in the Vistula on May 24 when leaving the Schichau yard for her preliminary trials. The river at this point is extremely difficult to navigate, and on previous occasions vessels of deep draft have often been within an ace of going ashore. Four tugs had charge of the *König Albert* during the passage, and it was the snapping of one of the cables just as the battleship was rounding the island of Holm that led to the mishap. Fortunately the river bed is soft, and although for some hours the task of refloating her seemed doomed to failure, when she finally got off the ship was found to have sustained no damage whatever, and as soon as open water was reached the trials commenced according to program.

The *Blücher* went ashore in a fog in the Great Belt on May 29. In order to refloat her coal, stores, and even some guns had to be removed. The cruiser *Augsburg* and dockyard tugs finally pulled her off. The damage is considerable, requiring two months repairs. A court-martial was held at Kiel, when the captain and the navigating officer of the cruiser were found guilty of negligence, and sentenced respectively to three and six days arrest. As the *Blücher* is the principal gunnery ship at the Sonderburg school her temporary disablement will cause some inconvenience, and the *Yorck*, which has just been withdrawn from the North Sea cruiser squadron, is to be commissioned as gunnery ship with the *Prinz Adalbert*.

GREAT BRITAIN.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Ajax	23,500	21	10 13.5-in., 16 4-in.	Scott (Greenock)	Commissioned
Audacious	24,000	21	same	Cammel Laird (Birkenhead)	Under trials
Benbow	26,000	22	10 13.5-in., 16 6-in.	Beardmore	Laid down May 30, 1912
Delhi	26,000	22	same	Vickers	" May 31, 1912
Iron Duke	26,000	22	same	Portsmouth	Launched Oct. 12, 1912
Marlborough	26,000	22	same	Devonport	" Oct. 24, 1912
Qu'n Eliz'b'h	27,000	25	8 15-in., 16 6-in.	Portsmouth	Keel laid Oct. 21, 1912
Warspite	27,000	25	same	Devonport	" " " 31, 1912
Valiant	27,000	25	same	Fairfield	Laid down Jan. 31, 1913
Barham	27,000	25	same	Brown & Co.	" " Feb. 24, 1913
Battle Cruisers					
Queen Mary	28,850	30	8 13.5-in., 16 4-in.	Palmer	Commissioned
Tiger	28,850	25	same	Brown & Co.	Laid down June 20, 1912
Light Cruisers					
Nottingham	5,400	25	9 6-in., 4 3-pdrs.	Pembroke	Launched April 18, 1913
Birmingham	5,400	25	same	Elswick	" May 7, 1913
Lowestoft	5,400	25	same	Chatham	" April 23, 1913

"AJAX."—The results of the steam trials of the *Ajax*, battleship, built and engined by Scotts' Shipbuilding & Engineering Co. (Limited), Greenock, show that in every respect the requirements of the contract have been fully met. On the full-power trial of eight hours duration it was found that the power developed was just over 28,000 shaft horse-power, the four turbines running at an average of 330 revolutions per minute. Six runs were made over the measured mile at Polperro, when the speed was almost exactly 21 knots. The vacuum in the condenser was creditably high, and

the coal consumption worked out to 1.69 pound per shaft horse-power per hour. On a further trial the turbines were "opened out," and the power maintained at a considerably higher total than that given, the speed being over 22 knots. On the 30 hours trial the turbines, working at 290 revolutions maintained a power of 19,830 shaft horse-power, and the speed of the ship was specially satisfactory at this rate.

"AUDACIOUS."—This vessel is completing her trials and is a sister ship to the *King George V.* Main details of this class are: Length, 555 feet; beam, 89 feet; designed speed, 21.5 knots, with turbines of 31,000 horse-power; main armor belt, 12-inch Krupp. A fact worthy of notice is that this vessel is the last English battleship to have a low-power torpedo-defence battery, the next class being armed with 6-inch for that battery thus following Semenoff's teaching and the trend of other navies. She should have been delivered on January 16, but has been delayed by labor strikes. Captain Cecil Frederick Dampier, forty-five years of age, has been detailed to command her.

"QUEEN MARY."—The new battle-cruiser *Queen Mary*, built by Palmer's Shipbuilding Co., Jarrow, has successfully completed her official trials, which have been carried out under rather trying conditions. The 24 hours progressive trial was run in a fog, which necessitated slowing down several times; and during her 24 hours trial at 56,000 horse-power a strong southerly wind, which reached almost the force of a gale, was experienced. For the greater part of the 24 hours the vessel kept well out to sea, and at times enormous waves swept the decks from stem to stern, but no damage was caused, and the ship behaved well. The engines also worked very smoothly. As usual, the strictest secrecy is being observed with regard to the speed attained, but it is stated that the top speed reached in the course of the trial which was completed on Saturday morning was 27 knots. If that is correct, it must be regarded as highly satisfactory, as it is only one knot below the vessel's designed speed at full power.

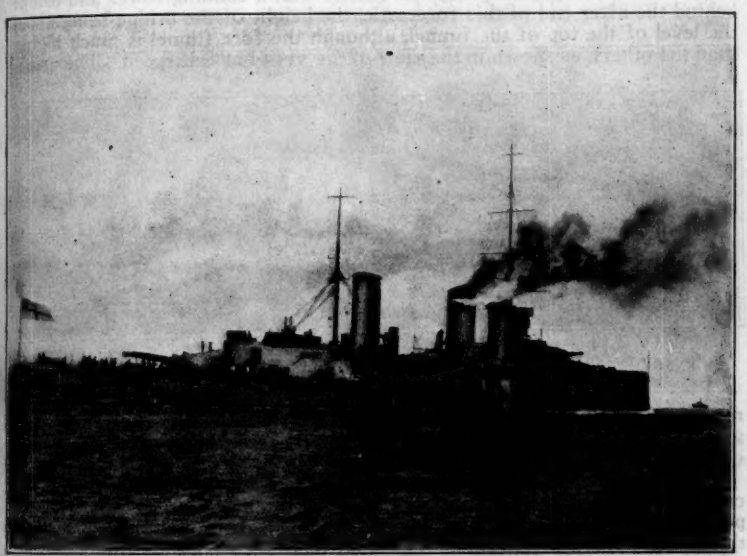
The *Queen Mary* belongs to the *Lion* class, the most important difference in the design being the addition of 6 inches to the beam and of 650 tons to the displacement. In order that the speed should be the same, notwithstanding the increase in displacement, the designed power, says *The Times*, was increased to 75,000 shaft horse-power, so that she is the most powerfully engined warship yet built in this country. The steam trials were of a very searching character, but so satisfactory did everything prove in the course of the tests that the whole of the trials were completed within six days. The ship has made a series of trials of considerable duration at progressive powers, runs being made at each of these powers over the measured course at Polperro in order to determine the speed, and consequently the radius of action, at the different rates. After these a trial of 24 hours duration was made at four-fifths of the full power, and subsequently of eight hours duration at full power.

The *Lion* and the *Princess Royal* exceeded their designed power by 6000 shaft horse-power, the speed realized being 28.5 knots and the coal consumption 1.7 pound per shaft horse-power per hour. The results in the case of the *Queen Mary* do not differ more than 1 per cent when compared with those of the *Princess Royal*, whether regard be had to the power developed, the speed attained, or the economy achieved. As regards speed, there can be no doubt that all three battle-cruisers can easily maintain 28½ knots.

The length of the *Queen Mary* is 700 feet; beam, 87 feet; displacement about 27,500 tons; and indicated horse-power about 75,000. Parsons' turbines have been supplied by Messrs. John Brown & Co., and have been arranged to drive four shafts. Steam is supplied by 42 water-tube boilers, of which 28 were built at Clydebank, and 14 at Jarrow.

The *Queen Mary* resembles in shape the *Lion*, but has a finer after run, obtained by her increased length. There, are, however, changes of importance in her equipment based on the experience gained in the earlier vessel. The funnels are of greater diameter, the forward pair being of the same dimensions and round in shape, but the after one is oblong.

The main armament consists of eight 13.5-inch guns, and each barbette has a set of range-finding and control instruments. The auxiliary armament, consisting of sixteen 4-inch guns, is well disposed, eight forward and eight aft, all on the same deck level, thus giving a clear space for the second pair of 13.5-inch to train on the extreme after bearing and providing for 50 per cent of the guns being concentrated on any bearing. All the guns are protected by frontal semicircular armored shields, giving a maximum protection against shell splinter.



Frank Gana.

THE BATTLE-CRUISER "QUEEN MARY."

The main conning-tower, situated just abaft the second barbette, is of the latest enlarged type, and will have a duplicate set of the new fire-director and ranging instruments in direct communication with each barbette; also a pair of the new type telescopic-sighted Whitehead torpedo directors. A smaller armored observation tower is mounted on the after superstructure.

The mast equipment, which is similar to that of the *Lion*, namely, single without tripod support, is to be exchanged for the modified tripod, as fitted in the *Centurion*, at the conclusion of the trials and before the ship is commissioned.

The *Queen Mary* has a covered stern walk, and the fitting up of the living spaces, which extend almost from end to end of the ship, is considered very satisfactory.—*Naval and Military Record.*

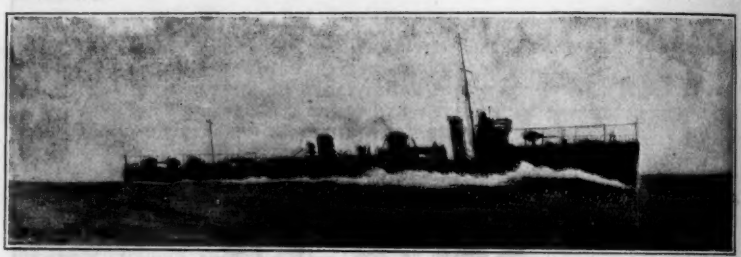
This and a heavy stern anchor are the only differences in appearance from the *Lion* and *Princess Royal*.

Naval opinion is favorably impressed with the equipment of this latest dreadnought unit, which reflects credit on the firm responsible for her construction (Palmer & Co.), but it is considered that the torpedo armament

of two 21-inch tubes is inadequate. The *Tiger,* battle-cruiser, has five 21-inch tubes.

LIGHT CRUISER.—A new light cruiser was laid down at Pembroke dockyard on July 21. Oil burning only. Displacement is 3700 tons and will have 4-inch armor. This type is expected to prove invaluable as a part of a battle screen.

DESTROYERS "SHARK," "SPARROWHAWK" AND "SPITFIRE."—The vessels of this class, twenty-three of which are now in commission, have a length of 260 feet, a beam of 27 feet, a draft of 9 feet 4 inches, and a displacement tonnage of 935 tons, of which 373 tons are due to the weight of the hull. The vessels have been designed to steam at full speed in a heavy sea, and thus they have an exceptionally high forecastle with a conning-tower and bridge behind the after end of this forecastle, the height of the bridge being about the level of the top of the funnel, although the fore funnel is much higher than the others, as shown in the view of the vessel at full speed. The armament includes three 4-inch guns, one mounted on the forecastle, one right aft, and another near the stern. There are two torpedo-launching tubes, one amidships and one aft.



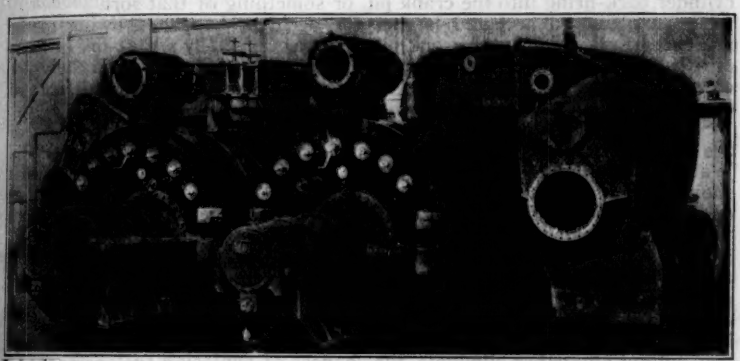
BRITISH DESTROYER "SHARK."

The propelling machinery arranged for driving the twin screws, with the condensers alongside each unit, was designed to develop 24,500 shaft horsepower in order to ensure a speed of 29 knots. This result was easily achieved, the average speed of the three vessels on their six runs over the measured mile, made in rough weather in each case, being about 30¾ knots, with an average mean shaft horse-power of about 25,400 for 635 revolutions. This power was maintained for eight hours in all three vessels, the oil consumption working out at about 1 pound per shaft horse-power per hour.

These twenty destroyers are the first with twin screws; the earlier vessels had the three-screw arrangement of turbines. Twin screws have much in their favor, whether considered from the standpoint of facility of operation, maneuvering, supervision, or with regard to the question of propulsive efficiency. There are, as illustrated, two independent turbines, each driving its own shaft and propeller. Each turbine is of the ordinary Parsons' type, with ahead-going and astern-going sections incorporated in the same casing. An impulse wheel with special blading or buckets is fitted to both the ahead and astern turbines, to deal with the highest pressure steam, the ahead impulse wheel being at the forward end, and the astern impulse wheel at the aft end. Steam is admitted to the ahead and astern turbines through groups of nozzles, each group having a controlling valve. The steam after leaving the impulse wheels is further expanded through a number of stages fitted with the usual reaction blading of the Parsons' type, the combination of the impulse and reaction sections resulting in a most economical arrangement. The number of groups of nozzles open to

steam at any one time can be regulated to suit the condition under which the turbine is working, and by this means an excellent economy at low or cruising powers, as well as at high powers, is successfully ensured. The position of the controlling valves for steam to the nozzles for the ahead-going turbines is clearly indicated on illustration; while a further reference to this shows immediately above these valves the specially designed main steam strainers and balanced expansion joints.

The boilers are of the Yarrow water-tube "Express" type, and were entirely constructed at the engine-builders' works at Wallsend. They are of the design and arrangement now usually adopted for this class of vessel, and embody all the more recent improvements in minor details which experience has shown to be beneficial. The automatic feed-water regulators, as fitted to the boilers, were supplied by Messrs. A. G. Mumford, Limited, Colchester. The fuel used for the boilers during the trials was a heavy oil of the quality as generally supplied to the Admiralty. The oil-burning sys-



MACHINERY OF THE DESTROYER "SHARK."

tem is of the usual Admiralty pressure system, the working of which on the trials was eminently satisfactory, as demonstrated by the ample and steady supply of steam under all conditions.—*Engineering.*

SUBMARINES.—The first of the two built at Vickers for the Australian Government was launched May 21. These vessels are like the *E* class and are to be designated *A-E 1* and *A-E 2*. They are 175 feet long, 19 feet wide, and displace 800 tons submerged. They are driven by two heavy oil engines of 800 horse-power each. The speed is 15 knots on surface. The torpedoes are 21-inch and there are two aircraft guns.

ACTIVITY OF THE FIRST LORD.—The *Moniteur de la Flotte* states that since October 31, 1911, when Mr. Churchill became First Lord of the Admiralty the yacht *Enchantress* had cruised 19,705 miles, burned 4900 tons of coal, and among other cruises made two in the Mediterranean. The First Lord had spent 182 days at sea, had visited all the ports in the British Isles having any relation with the navy and inspected all the royal dockyards there and in the Mediterranean. He had visited 60 or 70 battleships and cruisers without counting the destroyer and submarine flotillas, and watched 30 or 40 maneuvers by day and night.

ORGANIZATION OF CRUISERS.—Cruiser organization in the British Navy underwent a further change recently when the ten small cruisers (eight protected and two unarmored) which are attached in pairs to the first five battle-squadrons were withdrawn from that service and formed into two

"light cruiser squadrons" of five vessels each. In their place each battle squadron will have only one small cruiser. In the case of the four fully commissioned squadrons this vessel will be withdrawn from the active destroyer flotillas and will be of the *Boadicea* type. The *Boadiceas* will remain with the battle fleets, and the two light cruiser squadrons of five ships will presumably remain as they stand.

EXPLOSION IN A SUBMARINE.—On morning of June 7, while submarine *E 5* was on her way from Barrow to Portsmouth under convoy of the tender *Adamant*, an explosion occurred, 12 men being injured, one of them, Chief Engine-Room Artificer J. C. Greenall, fatally, while Engineer Commander W. L. Moore, who was burned and had both legs broken, died later after his legs had been amputated.

Lieut. Commander C. Land was in command of the boat, and that the explosion occurred under the engine, and must have been caused by the cylinder back-firing into the crank pit, or something of that sort.

The explanation accepted is that the accident happened owing to the presence of oil vapor in the crank pit, and was caused by a back-fire or flame escaping through the cylinder rings into the crank pit, which fired the vapor collected in the pit. Back-firing is a common occurrence in this sort of engine.

Submarine *E 5* is an entirely new vessel. The *E* class, of which sixteen are built or building for the British Navy, was designed by Sir Philip Watts. Not only in size and power, but in the type of propelling engines, it showed an advancement over previous classes. The length is 176 feet, as compared with 135 feet, in the *C* class; the submerged displacement about 800 tons, as compared with 321 tons; the indicated horse-power 1600, as compared with 600; and the speed 15 knots, an increase of two knots. Both for surface and for submerged running, the *E* vessels are fitted with more powerful engines than have ever before been placed in a submarine. The means of propulsion on the surface is by internal combustion engines using heavy oil under conditions which it was hoped would lessen considerably, if it did not altogether eliminate, the chances of explosion such as occurred to some of the early submarines.

A collision occurred on June 2 off the eastern end of the Isle of Wight between a battleship and a submarine. The *Prince of Wales*, flagship of Rear Admiral R. G. O. Tupper, left Portsmouth in the morning, accompanied by the battleships *Irresistible* and *Venerable*, to rejoin the flag of the vice-admiral commanding the Second and Third fleets for an instructional cruise, and a section of the Portsmouth submarines was told off to make an attack on the three ships as they passed out of the eastward entrance of the Solent. The submarines included *E 1* and *C 32*, and in some way not yet explained *C 32* and the *Prince of Wales* came into collision, the conning-tower and upper works of the submarine being carried away, while the bows of the battleship were so badly damaged that she was obliged to return to Spithead. The *Irresistible* accompanied her, to be at hand in case of need. The submarine had a marvelous escape, but by using her submerged steering gear she made her way back to harbor, and berthed alongside the submarine depot at Fort Blockhouse. The *Prince of Wales* anchored at Spithead, and dockyard divers were sent to her in a tug.

FLEET AUXILIARIES.—Perhaps the best definition of a fleet auxiliary is a vessel which contributes towards the efficiency of the fleet without being itself a fighting unit. It would thus embrace such vessels as the depot ships of destroyer and submarine flotillas, repair ships, hospital ships, fuel-carrying vessels, etc. Reckoning only the sea-going vessels discharging these duties, there was in 1905 a total of eleven only—six depot ships for torpedo flotillas, one repair ship (*Assistance*), one collier (*Kharki*), one distilling ship (*Aquarius*), one oil-carrying ship (*Petroleum*), and one hospital ship (*Maine*). To-day there are no fewer than forty-one ships fulfilling one or

another of these duties. The number of destroyer and submarine depot ships has increased to twenty-four (including the *Woolwich* and the *Tabaristan*), while the *Hermes* has been appropriated for the naval air service. The *Assistance* has been joined by the *Cyclops*, while a third fleet repair ship, the *Reliance* (ex-*Knight Companion*), is being fitted out at Devonport. The *Kharki* has been replaced as a collier by the *Mercedes*, she having herself been converted into an oil-carrying ship, of which type of auxiliary no fewer than eleven are now either in service or under construction.—*Naval and Military Record.*

THE ENGLISH MANEUVERS.—These commenced at midnight Thursday, July 10. The fleets engaged were composed as follows:

Class.	Number.	Tonnage.
Super-dreadnought battleships	6	136,000
Dreadnought battleships	10	201,350
Other battleships	25	379,700
Super-dreadnought cruisers	2	52,700
Dreadnought cruisers	3	53,250
Other armored cruisers	26	312,650
Total armored ships	72	1,135,650
Protected and unprotected cruisers and scouts	34	188,380
Mine-layers	7	24,200
Mine-sweepers	6	4,635
Destroyers	159	98,513
Submarines	42	17,031
Depot ships, t. b. d.	11	65,440
Depot ships, subs.	8	22,380
Euryalus, Hermes, Sappho, Swift, Cyclops, Assistance and *Maine*	7	48,610
Grand total	346	1,604,889

The officers flying their flags or broad pennants in the chief or subordinate command of fleets and squadrons comprised 1 admiral, 6 vice admirals, 14 rear admirals and 4 commodores.

This fleet was sub-divided into the enemy or Red and the defending or Blue fleet. Sir George Callaghan, in the *Neptune*, commanded the Blue and Sir John Jellicoe, in the *Thunderer*, commanded the Red. Rear Admiral de Robeck in command of the patrols, and Commodore Roger Keyes the head of the submarine service also took part. The forces in the two fleets were as follows:

	Blue.	Red.
Battleships	25	16
Battle-cruisers	3	2
Armored cruisers	20	6
Cruisers	26	8
Destroyers	104	55
Submarines	30	17
Mine-layers	7	0
Total	215	104

The preponderance in the force of Red over that of Blue was thus closely in ratio to that of the German fleet to that of the English.

The cruisers for the first time were organized into separate squadrons and flag officers ordered to command them. This is a departure from custom and the only precedent is the maneuvers of 1893 when the light cruisers

were organized into groups, but no flag officers were ordered to command.

Forty per cent of the coast guard service was drawn upon to fill the complements of the fleet.

Four fast hired transports were also attached to the Red with three battalions of infantry and one battalion of marines embarked therein. The cyclist coast patrol acted in conjunction with Blue.

The actual use of troops as a raiding party add to the value and interest of the proceedings. Hitherto military forces in naval maneuvers have been imagined, and this circumstance has always detracted from the actuality of the operations.

The Problem.—The problem was: admitting in case of war, that the menace of destroyers and submarines made it advisable to keep the Blue battle-fleet out of the North Sea, would it be possible for Red acting at a selected moment to throw a raiding force of any considerable strength on the East coast.

Bases.—Red had the ports on the east coast from Yarmouth to Dover, and Blue the remainder of the coast of the British Isles.

The *Pall Mall Gazette* considered the coast badly divided and that the Red fleet could not succeed because:

(1) It has insufficient cruisers to deal with torpedo-craft attempting to attack its transports;

(2) All the mine-layers have been allotted to the other side, and the Blue fleet has, therefore, an unhampered liberty of action;

(3) The coast-line open to attack has been unduly curtailed, and the strategical area thrown too far north and in too close proximity to the bases of the British fleet.

Execution of the Problem.—Seventeen Blue destroyers, together with the cruisers *Leander, Bonaventure* and *Sappho* were on patrol duty at entrance to river Humber. In the early hours of the morning of Friday, July 25, scouts reported the Red fleet steaming northward towards Flamboro. The *Leander,* with the destroyers, followed hugging the shore, leaving but a few destroyers and two cruisers in the Humber. Red's armored vessels appeared and the small Blue fleet retreated to Hull. The Red transports *Plassey, Rewa, Dongola* and *Rohilla* steamed up the river and landed their troops at Grimsby and Immingham. At Immingham, however, whence the *Rohilla* and *Rewa* were alongside the jetties the Blue destroyers torpedoed them. The Red were opposed by the local Blue forces, but the latter were driven off. Red stationed the *Cornwall* and *Cumberland* off the mouth of the Humber as a guard.

The weather was fine and the sea comparatively smooth, and so far as could be seen, there was no likelihood of the patrolling cruisers being suddenly attacked. But while the enemy's fleet was busy in the mouth of the Humber, the flotilla of torpedo craft belonging to the defenders had been not less active. Although every officer and man on the bridge and upper deck of the *Cornwall* was on the qui vive, it was not until two submarines —*C 12* and *13*—which had approached submerged, had got within a stone's throw of the cruiser, and "bobbed up" on the surface, that anyone on board the *Cornwall* was aware that hostile craft were in the vicinity. The submarines claimed to have torpedoed the cruiser, and that claim was allowed by the umpire.

That night, July 24, the Red fleet sent eight destroyers up the Humber to Hull to destroy the Blue vessels there, and this attack was successfully repulsed by the Blue. Two Blue submarines torpedoed the Red battleship *Duncan* off the Humber, they approaching under cover of a steam trawler.

On Saturday, July 26, the Red fleet raided the Wear and Blyth and captured Sunderland and Blyth. The coast guards never anticipated that Sunderland would be selected for landing, and before the Territorial cyclists sighted the fleet it was within striking distance. The defenders only mustered two hundred strong, and the attacking fleet, which consisted of a first-class armored cruiser, two transports, and three torpedo-boats, was not

challenged, and landed 700 marines under cover of the cruiser's guns. The Red fleet had encountered the Blue fleet at sea and compelled it to retire.

Blyth was captured in even smarter style. Two cruisers, seven destroyers, and two transports of Red fleet were sighted at daybreak. Cyclists were telephoned for, and a party of four men in camp was despatched, followed by Maxims, but the invaders had landed 1000 men, and the cyclists stationed on the breakwater and among the sand hills made only a feeble resistance. The invaders captured the Maxims and landed a battery of twelve-pounders. All the defenders were captured. Previously the invaders had captured a destroyer and submarine, but not before the submarine had put the transport out of action.

On Saturday morning, July 26, the Blue battleship *Commonwealth* was torpedoed in the North Sea, near the Cromarty Firth, by a submarine. Later on Saturday afternoon one of the seaplanes, operating from Cromarty aviation base, and scouting far out in the Moray Firth, reported sighting a submarine. A defending torpedo-boat, guarding the entrance to the Cromarty Firth, then found and "sank" the submarine, which proved to be *73*, of the Red fleet, and which then proceeded to Cromarty.

Most useful scouting work was done from Cromarty by Lieutenants Longmore, Oliver and Rathborne, the pilots of the seaplanes. These were three in number—two biplanes and a monoplane.

In the various encounters many ships were put out of action. By Saturday noon, July 26, four Red battleships and one Red cruiser, six Blue cruisers, a Blue battleship, and ten Blue destroyers were among the number.

This stage of the naval maneuvers terminated at noon on Monday, July 28. Thereupon certain regulations which have been in force were relaxed, and war stations were demolished.

The Admiralty have directed that Royal fleet reserve men, Royal Naval Reserve, and Royal Naval Volunteer Reserve men embarked for the maneuvers, are to be sent to their homes on Saturday the 9th proximo and not on the 10th as previously ordered.

The Final Stage.—This began July 31 and ended August 21. Details of the scheme upon which the concluding phase of the maneuvers was based have been kept so secret that many of the officers and men serving in ships that have returned to port seem to have but a hazy idea of the scheme generally; but the two fleets, Blue and Red, have covered a considerable area—from the Nore to the north of Scotland—and the general impression is that the task assigned to the Blue (defending) fleet, under Admiral Sir George A. Callaghan, was to prevent two Red fleets, each numerically weaker than Blue, from joining. No attempts at landing took place.

EFFICIENCY OF THE PERSONNEL.—At a time when the fleet is carrying out maneuvers which are probably the most practical and comprehensive ever undertaken by any naval fleet, it is not inappropriate, says *Engineering*, to reflect briefly upon the situation as regards the officers of the navy. . . . . The officers of the fleet in every branch of the service have had a strenuous time, not only because of the size of the squadrons and the great speed at which the tactical exercises have been carried out, but also because of the thick weather that has prevailed in the North Sea during that period. The engineering officers, who are too frequently forgotten in the conferring of praise on such occasions, have especially experienced a severe strain, because of the constant steaming at high speed and the number of supervisory officers in the machinery compartment of the ship as compared with those on the military staff. The fact that there is an entire absence of "lame ducks," proves not only the reliability of the matériel from the point of view of design and construction, but also the efficiency and experience of the personnel. Time was, and not so many years ago, when the tale of machinery failures in ships during maneuvers was at least disquieting to the lay mind, and consequently the satisfactory result of the present tactical exercises from this point of view ought to be made widely known, because it brings comforting assurance to the nation for the future.

HOLLAND.

The report of the commission appointed to inquire into the defence of the Dutch East Indies declares that it is necessary to build a fleet of nine dreadnoughts of 21,000 to 22,000 tons each with a speed of 21 knots, six torpedo-cruisers of 1200 tons with a speed of 36 knots, eight destroyers, and 44 torpedo-boats of 300 tons each, and 22 submarines. This fleet should be divided for service in the Indies and in home waters. The commission recommends oil as fuel.—*Army and Navy Gazette.*

A period of 35 years is fixed for the completion of the scheme, and the annual expenditure is estimated at 45½ million florins (about £3,791,000). The commission proposes that liquid fuel shall be employed by the fleet.—*Reuter.*

THE DUTCH NAVY.—Three torpedo-boat destroyers, with a displacement of 480 tons each, and a designed speed of 30 knots, are now in course of construction for the Dutch Indies; four torpedo-boats, with a displacement of 180 tons each, and a designed speed of 25 knots, for Holland; three gunboats, with a displacement of 800 tons each, fitted with Diesel engines, and to have a speed of 14 knots, for Holland; two submersibles, with a displacement of 150 tons each, for Holland; and one submersible, with a displacement of 350 tons, for the Dutch Indies. Besides these units, the Dutch budget for 1913 provides for the laying down of eight torpedo-boats, with a displacement of 200 tons each, and to steam at the rate of 26 knots; two submersibles, with a displacement of 200 tons each, and to steam at 16 knots; and two submersibles, with a displacement of 350 tons each, and to steam at 16 knots. The first two submersibles are to be built for service on the Dutch coast, and the second two for service in the Dutch Indies.—*Engineering.*

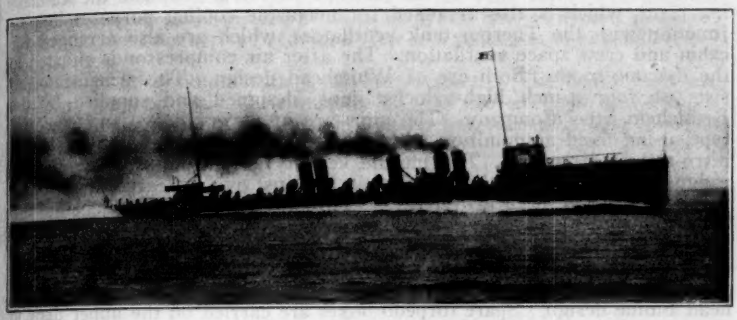
GREECE.

THE GREEK TORPEDO-BOAT DESTROYERS OF THE "LION" CLASS.—In July last year, with the object of strengthening its destroyer flotilla, the Greek Government purchased the then nearly completed destroyers *V 5* and *V 6*, which were under construction at the Vulcan Company's works at Stettin for the German Government. These vessels now appear in the Greek Navy as the *Neagenea* and *Keraunos*. They are of 700 tons displacement and about 32.5 knots speed. Slight alterations to the vessel's armament were made to suit their purchasers, the gun armament being increased to four 23-pounders in place of the German two. These vessels arrived in Greece in September last and saw a considerable amount of war service in the last few months.

In addition to these two ships the Greek Government purchased the destroyers building by Cammel, Laird & Co., Limited, for the Argentine Government.

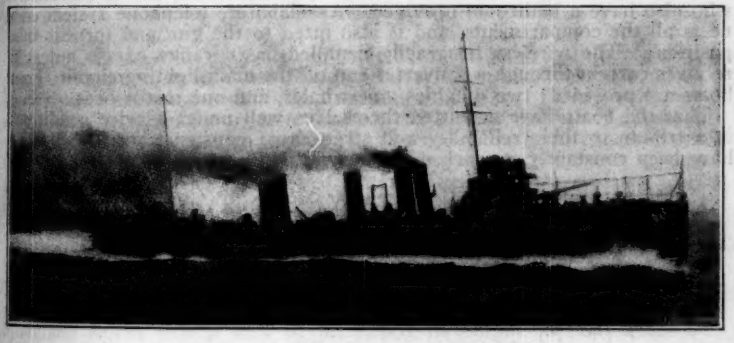
The four ships, now known as the *Lion, Eagle, Hawk* and *Panther* are large and powerful vessels of somewhat special design. Their length on the water-line is 285 feet, beam 27 feet 8 inches, and draft of water about 9 feet, the propellers projecting, however, considerably below this. At this draft their displacement is about 1050 tons. The designed speed of 32 knots was slightly exceeded on trial. They are in consequence somewhat between the ocean-going destroyers of five years ago and the latest British Admiralty vessels. A radical difference, however, lies in the arrangement of machinery, the armament and the general equipment, all of which embodied features seldom met with in this class of ship. The propelling machinery consists of two separate and independent steam turbines in two compartments separated by a transverse bulkhead. The combined power developed on trial was about 22,000 shaft horse-power, the turbines running at 620 revolutions. The design of the turbines embodies a high-pressure impulse wheel mounted at the forward end of the drum whereon are also mounted

about sixty rows of the ordinary Parsons' blading. The turbine cylinders are of cast iron. Steam is supplied by five boilers of the White-Forster type, the pressure being 230 pounds. The total heating surface is about 27,000 square feet. Each boiler is in a separate compartment. Fore and aft bulkheads run the complete length of the engine and boiler-rooms, forming side bunkers along the skin of the ship, and transverse coal bunkers are



GREEK DESTROYER "LION."

fitted opposite boilers 1 to 4. No. 5 boiler is oil-fired and has a heating surface of 8500 square feet. The total coal bunker capacity is 230 tons, with about 90 tons of oil, which is carried mostly in two main tanks at the ends of the vessel. It will be seen that the arrangement of bulkheads and coal bunkers adds enormously to the safety of the ship in the event of damage and greatly assists in the protection of the boilers in action. This renders the hull construction of these destroyers excellent from the point of



GREEK DESTROYER "EAGLE."

view of safety, but the multiplicity of compartments does not facilitate supervision. Two fan engines are fitted in each stokehold, and each boiler has one main and one auxiliary Weir feed pump. Two oil fuel pumps delivering oil through a boiler of large dimensions supply the oil boiler. Each boiler is fitted with a separate feed heater.

The remainder of the auxiliary machinery is of an elaborate nature. In each engine-room "Uniflux" condensers and a Weir "Dual" air pump maintain a vacuum of 28 inches when the vessel is running at full power. The two evaporators have a combined output of 40 tons per day. A 50-ton fire and bilge pump is placed in each engine-room; the steering engine is placed in the after engine-room. Bilge ejectors of high capacity are

fitted throughout in each main compartment. The engine-room ventilation is secured by means of electric fans.

The steam dynamos are situated in a separate compartment aft of the main engines. They are of the A. E. G. turbine type and supply all the power for ship lighting and for the two searchlights. *For harbor use an oil-driven dynamo is placed in the forward auxiliary machinery compartment,* where also are situated the forward air compressor and the ice-making plant, which is also arranged for magazine cooling purposes in conjunction with the Thermo tank ventilators, which are also arranged for cabin and crew space ventilation. The after air compressor is situated in the dynamo-room. Both are of Whitehead design. The armament consists of four 4-inch high-velocity guns, designed and supplied by the Bethlehem Steel Company. The guns are of a very heavy and powerful type, using fixed ammunition with a long pointed shell of 31 pounds and nitro-cellulose powder. The muzzle velocity is 31 foot-seconds, and the range at 5 degrees elevation 7970 yards. At just over 9 degrees the average range of twelve shots proved to be 10,768 yards. The Bethlehem "two hand" elevating and training mechanism is fitted, as well as the company's "Rock Bar" cross connected sights. Ammunition hoists operated by electric motors are fitted to both magazines, alternative hand gear being provided. The torpedo armament consists of four 21-inch tubes of Whitehead Fiume design. Spare torpedo boxes are carried on the upper deck in close proximity to each tube and are so placed as to permit of the tubes being reloaded with the spare torpedoes without lifting being required, as the boxes are adjacent and in line with the fore and aft position of the tubes.

The crew of ninety men including petty officers are berthed forward on two decks. A sick bay is provided, but seems an unnecessary refinement in view of the probable frequent presence of the almost essential parent ship. Elaborate ventilating arrangements—hot and cold air—are supplied throughout. Aft are found the wardroom, the captain's day and night cabins and private bathroom, and five other two-berth cabins for the officers, who also have a bathroom provided. An elaborate telephone system connects all the compartments, and is also fitted to the gun and torpedo-tube positions. The wireless telegraphy installed has a range of 250 miles; it receives current through a converter run off the main lighting circuit. Four boats are provided; two dinghies, one whaler, and one motor boat.

That the boats have acquitted themselves well under service conditions is a tribute to their reliability and strength of construction, for all four have been constantly at work.—*The Engineer.*

ITALY.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Cavour.....	22,000	22	13 12-in., 18 4.7-in.	Spezia	Launched Aug. 10, 1911
Giulio Cesare..	22,000	22	same	Ansaldo-Armstrong	Undergoing trials
Leonardo da Vinci	22,000	22	same	Genoa (Odero)	Launched Oct. 14, 1911
Andrea Doria.	22,400	23	13 12-in., 16 6-in.	Spezia	Launched March 30, 1913
Duilio.....	22,400	23	same	Castellamare	" April 30, 1913
Dandolo.....	28,000	25	8 15-in., 16 6-in.	Ansaldo	Laid down Dec., 1912
Morosini.....	28,000	25	same	Odero	" " Dec. 1912
Guiseppe Mazzini	30,000	25	8 15-in., 20 6.in.	Spezia	To be laid down in 1913
Goffredo Mameli	30,000	25	same	Castellamare	same

NEW VESSELS.—The Italian naval authorities have decided in favor of building 30,000-ton dreadnoughts instead of units having a 37,000-ton displacement, the main armament of which is to consist of eight 15-inch guns, to be mounted in four double-gun turrets. The secondary armament will comprise twenty 6-inch guns and twenty 3-inch guns. The belt-armor is to be 12.6 inches thick amidships. The program states that four such 30,000-ton battleships are to be completed by the year 1916. The decision to build 30,000-ton ships instead of ships of 37,000 tons as at first proposed is stated to have been arrived at with a view to a reduction in expenditure.—*Engineering.*

Speed is to be 25 knots with 50,000 horse-power. The heavy guns are 45 calibers long, with a muzzle velocity of 3149 foot-seconds, and firing a shell weighing 1422 pounds. The triple turret has been thus abandoned in favor of the double turret.

CONVERTING OLD BATTLESHIPS.—The defence of the Lybian coast has been put under the command of a rear admiral who has in his squadron the older battleships. The *Italia* has been reconstructed at Tarento, her old guns being replaced by modern weapons. The squadron comprises the *Dandolo, Lepanto, Etruria, Misurata,* a station ship; destroyers *Orsa, Olimpo, Orfio, Orione,* the battleship *Italia,* the *Carlo Alberto.*

TORPEDO BATTLESHIP.—General of Engineers Cuniberti proposes a ship armed principally with torpedoes and protected by partial submersion. All the middle portion of this vessel of 11,000 tons will be submerged; two armored turrets of 16-inch armor alone rise from the water at the extreme bow and stern, they contain each eight 6-inch guns to be used solely against torpedoes. The intervening hull will be occupied by six launching tubes, three each side, then by the forward motors, then by six other tubes, next the after motors, and then six more tubes. The portion of the hull reaching the surface and receiving the turrets will be protected by armor increasing in thickness as the protection afforded by the water decreases.—*Moniteur de la Flotte.*

SCOUT CRUISERS.—It is practically admitted officially that the two new 5000-ton Italian cruisers *Nino Bixio* and *Marsala* are unfit to encounter a heavy sea. A technical commission is sitting at Naples to consider measures which may be taken in order to correct the serious defects in these two vessels, but up to the present nothing has been decided upon except that no more cruisers of this type should be built. They are each 431 feet long and 42.6 feet beam, drawing 13.7 feet of water. The engines are of the Curtis turbine type.—*Shipping,* Illustrated.

DOCKYARDS.—Some important changes in the financial development and organization of the Italian shipbuilding industry are about to take place. The Cantieri Navali Riuniti have sold their Muggiano shipbuilding yard, near Spezia, to the Societa Fiat San Giorgio. The latter will extend its Muggiano works with a view of increasing its output of submarines and taking up the construction of Diesel motors for ships on a large scale. The Cantieri Navali also hands over its shareholding in the Fiat San Giorgio to the founder of the latter, the Fiat Motor Manufacturing Co., of Turin. The proceeds of these two sales will be used by the Cantieri Navali for redeeming about half of its bonds of 8,000,000 lire, which are still in circulation. The company, which during the six years of its existence has never paid a dividend, will also undergo thorough reconstruction, its capital being written down from 12,500,000 to 7,500,000 lire.

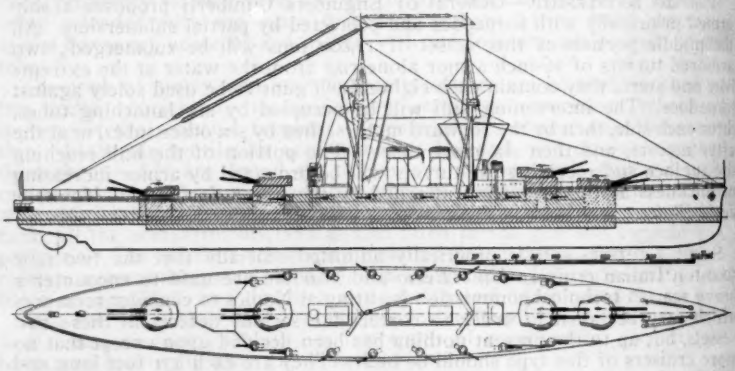
PERSONNEL.—Admiral Enrico Millo, 48 years of age, became Minister of Marine on July 28, succeeding Admiral Cattolica who retired owing to ill health.

JAPAN.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Fuso	30,000	22.5	10 14-in., 16 6-in.	Kure	Laid down March 11, 1912
Fuso 2d	30,000	22.5	....	Kawasaki	" " May, 1913
Fuso 3d	30,000	22.5	....	Mitsubishi	same
Fuso 4th	30,000	22.5	....	Yokosuka	same
Battle-Cruisers					
Kongo	27,500	27	8 14-in., 16 6-in., 8 t. t.	Vickers	Commissioned
Hiyei	27,500	27	same	Yokosuka	Launched Nov. 21, 1912
Haruna	27,500	27	same	Nagasaki	Keel laid Mar. 16, 1912
Kirishima	27,500	27	same	Kobe	" " Mar. 17, 1912

FUSO CLASS.—Jane gives their battery as ten 14-inch, and sixteen 6-inch, but the Naval Pocket Book gives it as twelve 14-inch and sixteen 6-inch.



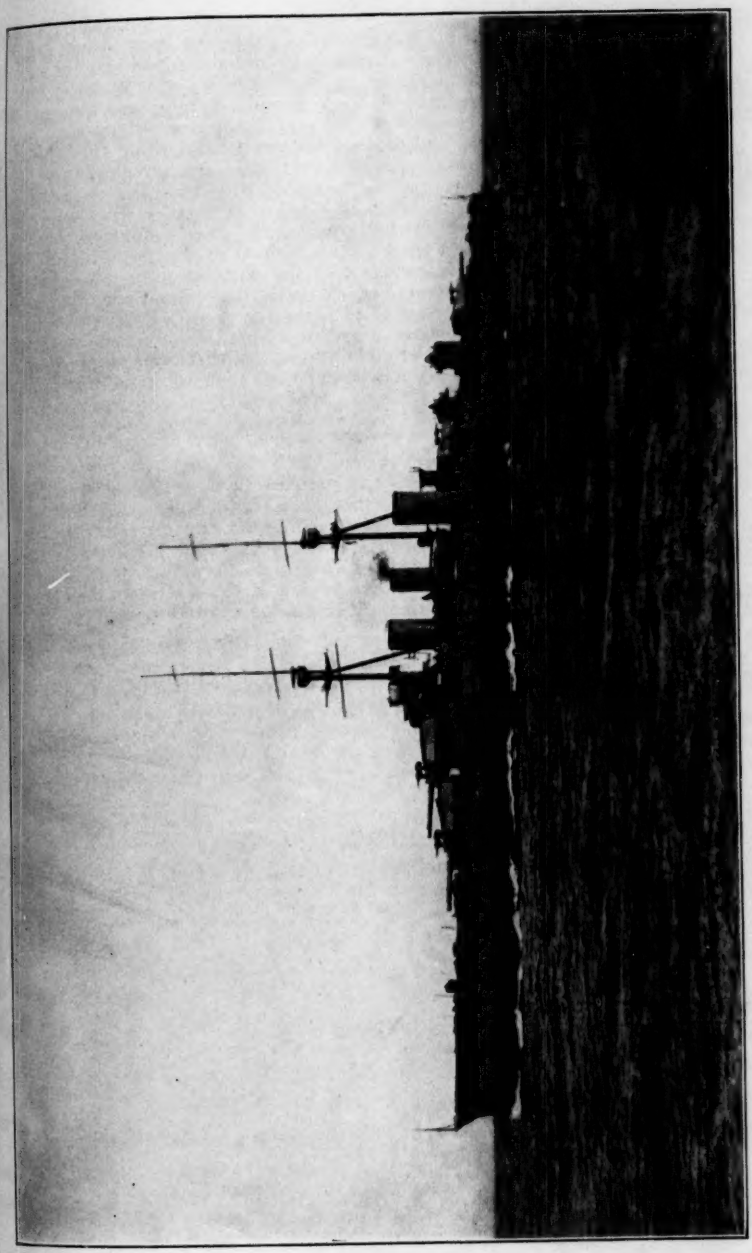
"KONGO."—This vessel sails for St. Vincent from Devonport en route to Japan on August 26. Captain Naoye Nakano is in command. She was laid down on January 17, 1911.

SUBMARINES.—The government has placed an order with Creusot for two submarines of 450 to 600 tons displacement.

MINISTER OF THE NAVY.—The selection of persons to fill the office of Minister of the Navy was formerly limited to admirals and vice admirals of the *active* list and to fill the office of Vice Minister of the Navy only vice admirals and rear admirals of the active list are available. An Imperial edict now makes officers of like rank who are on the retired list available.

PERSONNEL NOTE.—In order to economize, one vice admiral, two rear admirals, eight captains and twenty-six commanders have been retired, and the vacancies thus made have not been filled.

FLEET NOTES.—Important changes have just been carried out in the squadrons and other services of the navy. The reserve squadrons at the ports have been changed to station ships; the school ships no longer be-



JAPANESE BATTLE-CRUISER "KONGO."

longing to that division. The service of mines has been separated from that of torpedoes. The flotillas of torpedo-boats have been merged into groups of destroyers and torpedo-boats at each base under the command of a rear admiral flying his flag from a cruiser. The mines are placed under direction of the commandant of the base who is a captain in rank and who uses in this service the older torpedo-boats and, at Kuré, the submarines. The armored cruisers *Adzuma* and *Asama* become school ships for midshipmen. These, before their entry to the Naval Academy, are placed for four months on these ships which cruise independently and then unite into a division for cruising practice for midshipmen as soon as they enter the Academy. The battleship *Asahi* has relieved the *Fuji* as gunnery training ship. The first squadron reorganized and formed of the battleships *Settsu, Kawachi, Shikishima* and *Kashima* with the battle-cruisers *Kurama* and *Ikoma* has completed some maneuvers in the Bay of Hiroshima, their great gun and torpedo practice in the Bay of Kure and made a cruise from there to Formosa and to the southern ports of China. The second squadron composed of the armored cruiser *Idzumo* and the three new scout cruisers *Yahagi, Hirado* and *Chikuma* has completed a cruise to Formosa, the Korean ports and the north of China. The vessels in first reserve in the port squadrons have carried out target practice with guns and torpedoes.—*Moniteur de la Flotte.*

NAVAL ACADEMY COURSE.—This has been of three years duration, each year commencing August 1 and ending July 1 following. At the end of the third year the students pass for midshipmen and go afloat with the training squadron, thus getting their first sea duty after three years ashore. Now the naval cadets immediately on entering take a four months cruise on a sailing training ship. The course begins after these four months, the three years commencing the course not beginning until December 1.

NORWAY.

BATTLESHIPS.—The two building in Elswick works are now named the *Bjorgvin* and the *Nidaros*. They are of 4430 tons displacement, 295 feet long, 50.8 feet beam, drawing 16.5 feet of water. They are designed for 15 knots. Are propelled by turbines. Armor belt is Krupp 7.8 inches. Armament is two 11-inch, four 6-inch, six 4-inch with two submerged tubes. A crew of 250 is to be carried.

RUSSIA.

VESSELS BUILDING.

Name	Displacement	Speed	Armament	Builders	Remarks
Battleships					
Sevastopol	23,300	23	12 12-in., 16 4.7-in.	Baltic Works	Launched June 29, 1911
Petropavlovsk.	23,300	23	same	" "	" Sept. 9, 1911
Poltava.....	23,300	23	same	New Admiralty	" July 10, 1911
Gangut	23,300	23	same	" "	" Oct. 7, 1911
Emperor Alexander III	21,000	21	12 12-in., 20 4.7-in.	Nikolaieff	" July 24, 1912
Empress Marie	21,000	21	same	Ivan Bunge Co.	Laid down Oct. 10, 1911
Catherine II...	21,000	21	same	" " "	" " " "
Battle Cruisers					
Ismailia.....	28,000	27	9 14-in., 20 4.7-in.	Galerni	" " Dec. 20, 1912
Kinburn.....	28,000	27	same	Baltic Works	same
Borodino.....	28,000	27	same	Galerni	same
Navarino.....	28,000	27	same	Baltic Works	same

"CATHERINE II" CLASS.—These are driven by three Parsons' turbines. The vessels are to be launched before next spring. Armament as given in Jane is but ten 12-inch, arranged as in the *Gangut* class.

GUN FACTORY.—Many European firms submitted proposals for the establishment of a gun factory in Russia, and the award was made by the cabinet meeting at St. Petersburg to the Vickers Co.—*Moniteur de la Flotte.*

ACCIDENT ON A SUBMARINE.—On July 22, when the Russian submarine *Peskar* was off Windau, in the Baltic, her commander, Captain Wuerm, and his assistant, Engineer-Lieutenant Mesinow, were washed overboard and drowned. The *Peskar* was on a voyage from Libau to Reval, and was running half submerged in a very rough sea. Only the commander and Lieutenant Mesinow were on deck. When they were missed the submarine was immediately put about and the whole course retraversed, but no sign of either officer was discovered.—*Central News.*

SPAIN.

A new Spanish naval program has been in contemplation for some time, and will probably be begun in such a manner that there will be no necessity to reduce the staffs at Ferrol and Barcelona, where ships of the existing program are under construction. The new program tentatively embraces the construction of three more battleships of 21,000 tons each, two cruisers of 5000 to 6000 tons each, nine torpedo-boat destroyers and three submarines. The trials of the battleship *España* which was recently completed at Ferrol have begun.

TURKEY.

It is also generally understood that negotiations have been concluded between Tyne builders and the Turkish Government for the construction of two powerful dreadnoughts. Incidentally, the Turkish Government has arranged to take over from her erstwhile adversary, Italy, three old battleships which are to be refitted by the Italians before being handed over.

UNITED STATES.

VESSELS BUILDING.

Number	Name	Displacement	Speed	Armament	Where Building	Launched	% of Completion Aug. 1, 1913
	Battleships						
34	New York....	27,000	21	10 14-in., 21 5-in., 4 t. t.	N. Y. Navy Yard	Oct. 30, '12	85.8
35	Texas.....	27,000	21	same	Newport News	May 18, '12	91.7
						Laid Down	
36	Nevada.....	27,500	20.5	same	Quincy	Oct. 26, '12	40.3
37	Oklahoma....	27,500	20.5	same	Camden	Nov. 4, '12	37.7
38	Pennsylvania	31,400	21	12 14-in., 22 5-in., 4 t. t.	Newport News	May —, '12	2.0
39	....	31,400	21	same	N. Y. Navy Yard	....	....

THE NEW BATTLESHIP.—The acting Secretary of the Navy, Mr. Roosevelt, has signed the contract plans for battleship No. 39. This vessel was

authorized by act of Congress approved March 4, 1913. The limit of cost, exclusive of armor and armament, is $7,425,000. This and the sister vessel, the *Pennsylvania*, are the largest battleships yet designed for the United States Navy and, so far as known, the largest that have been designed for any navy. The vessel will be built at the navy yard, New York. The plans contemplate a vessel of the following dimensions: Length on designer's water-line, 600 feet; length over-all, 608 feet; breadth, 97 feet ½ inch; draft, 28 feet 10 inches; displacement, 31,400 tons; speed on four-hour trial, 21 knots; heavy battery, twelve 14-inch guns and four submerged torpedo-tubes, supported by a torpedo-defence battery of twenty-two 5-inch guns.

The vessel will be heavily armored and will be driven by Parsons' turbines and will be fitted with oil-burning boilers of the water-tube type.

Orders have been issued to start work on this vessel as early as practicable.

SUBMARINE TENDER "BUSHNELL."—Contracts have been signed at the Navy Department for the construction of the submarine tender *Bushnell* by the Seattle Construction & Dry Dock Company. This vessel was authorized by act of Congress approved August 22, 1912. The limit of cost is one million dollars. The *Bushnell* is designed to serve as a mother ship for a division of five submarines. Provision has been made for a division commander, as the tender serves as the flagship of the division. In addition to quarters for the officers and crew of the tender, quarters are provided for the officers and crews of the submarines, who will ordinarily live aboard the tender. The vessel will also have a capacity for a considerable quantity of stores and spare parts for the submarines, thus enabling these vessels to be encumbered as little as possible with weights not strictly required for offensive operations. In addition, the tender will carry sufficient fuel to give her a large steaming radius, with sufficient surplus to enable the fuel tanks of the five submarines to be refilled from the tender. The tender will also carry a reserve supply of torpedoes for the submarines and will have a fully equipped repair shop, including a small foundry. An interesting feature of the vessel is the cable-ship bow and lifting gear, which has been included in the design to enable the tender to carry on salvage operations in raising a sunken submarine from the bottom. While the vessel is not intended to undertake offensive operations on her own account, she will be armed with four 5-inch guns for her own defence.

STANDING OF VESSELS IN GUNNERY FOR THE FISCAL YEAR 1913.—Vessels of the battleship class:

1, *Idaho* (trophy winner); 2, *Virginia;* 3, *New Hampshire;* 4, *Michigan;* 5, *North Dakota;* 6, *Maryland;* 7, *Delaware;* 8, *Florida;* 9, *Utah;* 10, *Rhode Island;* 11, *Wyoming;* 12, *Connecticut;* 13, *Ohio;* 14, *Minnesota;* 15 *Saratoga;* 16, *Georgia;* 17, *Nebraska;* 18, *Colorado;* 19, *South Carolina, California, Kansas, Louisiana, Missouri, New Jersey, South Dakota* and *Vermont.*

Vessels of the destroyer class:

1, *Whipple;* 2, *Beale;* 3, *Ammen;* 4, *Stewart;* 5, *Monaghau;* 6, *Truxton;* 7, *Terry;* 8, *Henley;* 9, *Jouett;* 10, *McCall;* 11, *Warrington;* 12, *Decatur;* 13, *Paul Jones;* 14, *Roe;* 15, *Perkins;* 16, *Jenkins;* 17, *Walke;* 18, *Jarvis;* 19, *Paulding;* 20, *Dale;* 21, *Patterson;* 22, *Drayton;* 23, *Sterrett;* 24, *Burrows;* 25, *Preble;* 26, *Chauncey;* 27, *Trippe;* 28, *Fanning, Barry, Flusser. Hull, Lamson, Perry, Preston, Reid, Smith.*

The scores this spring are materially higher than those of last year in practically all forms of target practice. This improvement is very gratifying to the Department and is due to the establishment of definite schedules for progressive training, permitting better preparation for the various

exercises and also to the earnest efforts of those engaged in the competitions. The performances of the older ships have been particularly satisfactory.

BATTLE EFFICIENCY, UNITED STATES NAVY FOR YEAR ENDING JUNE 30, 1913.—The final standing in battle efficiency in the United States Navy among vessels of the battleship class shows the U. S. S. *Idaho* to be in the lead, while in the torpedo class the *Whipple* stands No. 1.

Final Standing—Battleship Class.

The multiples for gunnery and engineering have been reduced in such manner that the vessels standing one in each competition have been given 100 and the others properly scaled accordingly.

The multiples appearing in columns one and two are those reduced figures of merit:

No.	Name.	Gunnery. (1)	Engineering. (2)	Final merit.	Commanding officer.
1.	Idaho*	100.000	87.818	94.652	Capt. W. L. Howard.
2.	Utah	90.147	100.000	87.613	Capt. W. S. Benson.
3.	Michigan	87.100	77.908	83.421	Capt. E. E. Capehart.
4.	New Hampshire	87.367	66.401	78.505	Capt. J. H. Oliver.
5.	Florida	81.382	73.620	78.277	Capt. H. S. Knapp, Capt. W. J. Maxwell.
6.	Maryland	84.837	67.169	77.770	Capt. J. M. Ellicott.
7.	Delaware	81.750	70.808	77.373	Capt. J. Hood, Capt. H. Rodman.
8.	Wyoming	68.828	88.106	76.559	Capt. F. L. Chapin.
9.	Virginia	91.101	51.409	75.224	Capt. J. D. McDonald.
10.	North Dakota	72.584	58.474	75.165	Capt. H. B. Wilson.
11.	California	68.139	67.135	67.737	Capt. A. S. Halstead.
12.	South Dakota	72.684	69.832	67.483	Capt. C. P. Plunkett.
13.	Rhode Island	79.472	40.036	66.898	Capt. H. P. Jones, Capt. C. S. Williams.
14.	Ohio	55.349	63.422	58.678	Capt. C. C. Marsh, Capt. J. Strauss.
15.	Connecticut	58.088	56.283	58.930	Capt. H. Rodman, Capt. J. J. Knapp.
16.	Minnesota	52.120	59.186	54.946	Capt. G. R. Clark, Capt. E. Simpson.
17.	South Carolina	45.231	63.234	52.432	Capt. T. Snowden.
18.	Saratoga	51.014	55.238	52.228	Capt. H. A. Bispham, Comdr. H. A. Wiley.
19.	Nebraska	48.948	43.142	46.628	Capt. S. S. Wood.
20.	Georgia	30.535	37.262	45.256	Capt. M. Johnston.

* Pennant winner.

Final Standing—Torpedo Class.

No.	Vessel.	Gunnery.	Engineering.	Final merit.	Commanding officer.
1.	Whipple*	98.777	91.568	95.893	Lieut. M. K. Metcalf.
2.	Ammen	98.112	91.592	95.025	Lieut. W. H. Allen.
3.	Truxtun	92.546	91.627	92.178	Lieut. (J.G.) T. A. Symington.
4.	Stewart	93.853	80.271	88.420	Lieut. (J.G.) H. G. Shonerd.
5.	Beale	100.000	61.184	84.474	Lieut. E. C. S. Parker.
6.	Jouett	80.772	87.439	83.439	Lieut. Comdr. W. P. Cronan.
7.	Warrington	78.948	83.485	80.763	Lieut. W. Ancrum.
8.	McCall	80.066	79.423	79.809	Lieut. H. W. Osterhaus.
9.	Terry	89.140	60.641	77.261	Lieut. J. C. Fremont.
10.	Paul Jones	70.859	76.179	72.987	Lieut. (J.G.) H. C. Gearing.
11.	Monaghan	92.671	41.510	72.207	Lieut. Comdr. F. T. Evans.
12.	Decatur	71.394	57.443	65.814	Lieut. B. H. Green.
13.	Burrows	39.059	100.000	63.435	Lieut. Comdr. J. F. Hellweg.
14.	Drayton	52.826	76.536	62.310	Lieut. W. D. Puleston.
15.	Patterson	54.124	73.821	62.003	Lieut. H. R. Stark.
16.	Jarvis	58.932	64.286	61.074	Lieut. Comdr. D. P. Mannix.
17.	Walke	64.217	55.392	60.687	Lieut. C. R. Train.
18.	Perkins	68.581	48.843	60.686	Lieut. J. P. Jackson.
19.	Roe	69.319	46.163	60.057	Lieut. Comdr. C. H. Woodward.
20.	Jenkins	67.222	44.075	57.963	Lieut. Comdr. E. H. DeLany.
21.	Dale	55.021	60.063	57.038	Ensign F. T. Berry.
22.	Sterett	48.871	67.864	56.468	Lieut. C. T. Hutchins.
23.	Preble	33.644	83.841	53.243	Lieut. (J. G.) C. F. Pousland.
24.	Paulding	55.064	48.350	52.378	Lieut. Comdr. S. H. R. Doyle.
25.	Chauncey	32.421	67.467	46.439	Ensign E. M. Woodson.
26.	Trippe	28.385	46.193	35.508	Lieut. Comdr. F. D. Berrien.
27.	Fanning	16.975	42.342	27.122	Lieut. Comdr. F. N. Jeffers.

* Pennant winner.

Final Standing—Submarine Class.

No.	Vessel.	Gunnery. (1)	Engineering. (2)	Final merit.	Commanding officer.
1.	A-2*	86.718	42.943	69.208	Ensign G. Bradford.
2.	D-1	46.073	64.178	53.315	Ensign L. P. Warren.
3.	D-3	8.392	100.000	45.035	Ensign W. R. Carter.
4.	A-4	37.692	27.826	33.746	Lieut. (J.G.) E. D. McWhorter, Ensign W. H. Dashley.
5.	A-6	26.109	27.286	26.580	Ensigns J. C. Van de Carr, J. L. Ribeldaffer.
6.	A-7	94.112	28.458	67.859	Ensign C. M. Yates.
	D-2	27.970	35.510	30.986	Ensign R. A. Burg.
	E-1	16.528	47.355	28.859	Lieut. (J. G.) C. R. Hyatt, Lieut. L. D. Causey.
	E-2	0.000	26.483	10.593	Ensign D. C. Laizure.
	F-1	44.758	55.744	49.152	Lieut. C. E. Smith.
	F-2	90.768	48.033	73.670	Ensign F. Chew.
	F-3	100.000	49.232	79.693	Ensign K. Heron, Ensign W. R. Munroe.
	C-2	Did not	76.757	.....	Ensign E. F. Cutts.
	C-3	hold	34.811	.....	Lieuts. (J.G.) J. Parker, R. Edwards.
	C-4	battle	38.508	.....	Lieut. (J.G.) P. N. L. Bellinger, Ensign H. Gibson.
	C-5	practice	89.522	.....	Lieut. (J. G.) W. G. Child, Lieut. L. D. Causey, Ensign J. W. Rankin.

A-2, D-1 and D-3 were only submarines to conduct all forms of target practice and make all engineering runs.

* Pennant winner.

ORDNANCE AND GUNNERY.

GUNS AND PROJECTILES.

KRUPP GUNS.—The tables of ordnance given out by the Krupp concern last December indicate that that firm is manufacturing big guns of 40, 45 and 50 calibers and of 12-inch, 14-inch, 15-inch and 16-inch bore. According to particulars published in German papers, the guns supplied to the German Navy outclass the corresponding British naval ordnance. Owing to the secrecy maintained by German naval officials no confirmation of this statement can be secured. The following table shows the particulars of the largest Krupp naval guns:

	14-inch.	15-inch.	16-inch.
Length (incl. breech)	55 ft.	60 ft.	62½ ft.
Weight	62 tons	75½ tons	91½ tons
Weight of A. P. shell	1,365 lbs.	1,675 lbs.	2,025 lbs.
Weight of charge (full)	432 lbs.	530 lbs.	642 lbs.
Muzzle velocity	2,790 f.s.	2,790 f.s.	2,790 f.s.
Muzzle energy	73,722 f.t.	90,370 f.t.	109,380 f.t.
Penetration (of steel) at muzzle	43 in.	46 in.	49 in.

GERMAN ORDNANCE.—It would be interesting to hear the reasons which impel Germany to consider the 870-900-pound projectile of her 12-inch gun as destructive at battle range as the 1250-1400 shell fired by the British 13.5-inch B. L. Whatever those reasons are, they must be curiously at variance with the lessons of the Russo-Japanese War. The final and decisive sea action in that war represented a triumph for the big gun. The outstanding feature of Semenoff's account of the battle is his description of the appalling effect of the large H. E. shells which destroyed the Russian battleships, not so much by penetrating armor as by the sheer blasting force of their explosion. It is safe to assume that the bursting charge of a 13.5-inch shell is at least one-third heavier than that of a 12-inch shell. Therefore, the former projectile is certain to do more damage than the latter, other things being equal. Yet this supremely important aspect of the question is ignored by the apologists for the German 12-inch gun.

A 15-inch naval gun has been tested on the Krupp range at Meppen, with most successful results, and the significance of this report is now borne out by the *Marine Rundschau* revelations as to the fact that up to the *Ersatz Worth* no vessel in the German Navy carries a gun over 12 inches in caliber. The ballistics of the new 15-inch gun, as shown above, show it to be a very powerful weapon, and it has passed a long series of tests. The great weight of this gun and its mountings, together with the massive projectiles and heavy propellent charges used, render it impracticable to mount more than eight of the type in a ship of reasonable dimensions. Precisely the same considerations, it will be recalled, are understood to have governed the selection of the armament for the British *Warspites* now building. Unless all the published details of these last-named ships are inaccurate, Britain and Germany are now constructing battleships of very similar design, but it is impossible to say whether Germany is aiming at the high speed which is to be the feature of the *Warspites*. As regards battle-cruisers, it is noteworthy that Germany prefers sharply to differentiate them from battleships by giving them much lighter guns. Probably the intention is to sacrifice hitting power to speed and coal endurance.

TORPEDOES.

GERMAN TORPEDO RANGE.—Recently the new torpedo range at Eckernförde, distant some 20 miles from Kiel, was opened. Work on this range began in July, 1911, at which time the narrow limits of the existing range at Friedrichsort, adjacent to the state torpedo factory, had been found inadequate, in view of the rapid development of the torpedo. The new range is very extensive, and is said to be admirably adapted for experimenting with torpedoes of the latest type, as there is a clear run up to seven or eight miles. The buildings to accommodate the technical staff, together with the shops and practice pontoons, are situated near the hamlet of Altenhof, on the south side of Eckernförde Bay. Shortly after building operations commenced it was found that dredging on a large scale would be necessary to give a clear run along the range. In the last two years, therefore, about 100,000 cubic meters of sand have been removed. The entire cost of the range, including the dredging work and the erection of the buildings, amounts to £112,000. No warship is to be stationed at Eckernförde, but a tender belonging to the Kiel Torpedo School will be available for conducting tests out at sea. The staff at the new range will consist of picked men, as the work involved will naturally be of a highly confidential nature.

GERMAN TORPEDO.—A 21-inch automobile torpedo has just been adopted. It has a maximum range of 7000 meters at a speed of 29 knots. The bursting charge of this torpedo is very great, namely, 286.6 pounds of TNT. The trials have been far more successful than those of the 19-inch torpedo.

JAPANESE TORPEDO.—The *Kongo*, on her recent trials, lost a torpedo in Belfast Lough. The reward offered for its recovery was unusually large, viz: $972, and led to comments on its characteristics. Reliable papers state that it is a new type superior to the Hardcastle and that it has a range of 12,000 yards with a speed of 48 knots. The propellant is said to be superheated air. Forty of these torpedoes are on the *Kongo* for shipment to Japan.

RUSSIAN TORPEDO.—The type just adopted is similar to the French model 1909 R. It is 17 inches in diameter, 18.04 feet in length, with an explosive charge of 275.58 pounds. Its speed is 43 knots for 2000 yards, and 30 knots for 6000 yards. It is a very satisfactory torpedo to handle. It is claimed to be superior to the German torpedo. The Whitehead model is used.

ARMOR.

SCHAUMANN ARMOR.—This is apparently to prove a formidable rival to Krupp armor. It was rumored early in the year that Messrs. Krupp had acquired the sole producing rights of this armor, but evidently this was not the case, for an independent company is about to be formed for the supply of the Schaumann plating. In the opinion of experts who witnessed the initial experiments, Herr Oscar Schaumann's invention will effect something like a revolution in the armor-plate industry. Specimen plates made after his method exhibit a marvelous degree of resistance, far in excess of that shown by Krupp cemented steel, besides being much lighter. Some enthusiasts go so far as to declare that an inch of Schaumann steel is impervious to shot which easily perforates 1¾ inches of Krupp plate. When the invention first attracted public attention it was understood that it could be applied only to plates of moderate thickness, up to about four inches, but it seems that, on the contrary, the Schaumann method can be applied to armor of the greatest thickness. It is claimed that a warship protected by eight or nine inches of Schaumann armor would offer the same resistance to shell fire as a ship with a belt of 12-inch Krupp cemented steel, while the weight would correspond to that of a 6-inch belt of K. C. It is obvious that if a tithe of the claims put forward on behalf of the new armor are justified, the important question of protection will be enormously simplified.

The Schaumann method has been patented in England, the United States, and several European countries, but a German patent has still to be registered. The new company is to be known as the "Light Armor Company, Ltd.," with headquarters in Berlin. It is said that comparatively thin plates have repelled the attack of high-velocity armor-piercing projectiles, the shell in every case being shivered to fragments on impact after inflicting only a slight dent in the armor.—*Naval and Military Record.* (Notice of this armor was made on page 873 of No. 146 PROCEEDINGS.)

TARGET PRACTICE.

GERMAN RULES.—The *Elsass* has a remarkably good gunnery record behind her, and was selected to accompany the *Blücher* last year on a cruise to the Faroe Islands for the purpose of testing the value of new regulations formulated for the conduct of battle practice. On this occasion the two ships are understood to have engaged in heavy gun firing in exceptionally bad weather, at ranges much exceeding those which hitherto had normally obtained. The result of the test was reported to have vindicated the soundness of the new rules, which were accordingly adopted for the whole battle fleet.

"ORION'S" SHOOTING.—A year ago this vessel had competitive firing with the *Thunderer,* the latter being equipped with the Scott director. However in a very rough sea it was believed that the "Fire Director" would not have come out so well. The *Orion's* recent firing was to test out certain range keeping devices in conjunction with the "Fire Director." A device similar to the Pollen apparatus was used in order to keep the range automatically with a constantly changing target. The trials were very satisfactory.

POLLEN APPARATUS.—Mr. A. H. Pollen from an experience as a guest on the *Dido* in February, 1900, developed a range-keeping instrument. He worked on the supposition that (1) the only clue to the future position of the target is to be found in its past movements; (2) information of the latter must be observation of its various successive movements; (3) if these are plotted with allowance for the movement of the observer's ship through the water a plan would result; and (4) that from this plan the forecasting of the future ranges and angle of deflection must be a mere matter of calculation.

He succeeding in devising a method of ascertaining the target's speed and course that is almost automatic. His instrument combines the foregoing with change of range machine for automatically supplying a forecast of the ranges to the guns. This machine can be corrected for any change of course by the observer's own ship.

Mr. Pollen states the A C fire-control system, invented by Mr. Isherwood and himself, consists principally of (1) a group of instruments for ascertaining the target's range and movements; (2) of a device known as the Argo Clock, which uses the information gained by the first group to control the sights of the guns automatically. The first group has never been supplied for trial; the clock alone was tried for the first time about two months after monopoly had been abandoned.

POWDER.

A STABILITY TEST.—Assistant Chemist H. C. P. Weber, of the Bureau of Standards, proposes a test to consist in the determination of a time temperature explosion curve. The samples are chosen small enough to practically eliminate the factor of heat conductivity of the sample. The apparatus consists of a heating bath which may be kept at various constant temperatures. For this work the temperatures chosen were 200° C., 180° C., 170° C., 160° C. The length of time necessary for a sample to explode is determined with the aid of a stop-watch at one constant temperature, and then at the next, and so on. The results are plotted in a curve with time and temperature as ordinates and abscissæ.

That the results are reproducible to within a few per cent is shown by numerous repetitions. After the curve has been plotted by means of three or four points, determinations made at intermediate temperatures fall on the curve. The curve is, therefore, characteristic of the sample. It represents, in effect, the rate of change of decomposition velocity with change of temperature, and as such is an index of the stability of the powder.

Inspection of the curves shows that for stable powders there is a pronounced bend, while the ratio of explosion periods at 200° C. and 160° C. is at least 2:9. In the unstable powders this ratio falls as low as 2:3 and the irregularities become greater. It also becomes evident that one explosion temperature, even if time is considered, does not give much information.

It is possible that with sufficient accumulated data the test may throw some light on the actual effect of a stabilizer on the natural decomposition velocity of powders.

MARINE ENGINEERING.

GEARED TURBINES.—The *Ersatz-Hohenzollern*, the new German Imperial yacht, will, it is stated, have geared turbines on the Föttinger system.

PROPULSION PROBLEM IN SHIPS.—Papers read at Glasgow meeting of the Institution of Naval Architects.

Geared Turbines.—Dr. J. Inglis offered a paper "On the Trials of Ferry Steamers Propelled by Geared Turbines." The vessels were named *Curzon, Elgin* and *Hardinge*, after three Viceroys of India, and were intended to connect Ceylon with the Indian mainland by a short sea passage in smooth water, instead of the long and occasionally disagreeable voyages which hitherto had been the only available means of transit. The South Indian Railway Company, owners of the vessels, applied for guidance to the late Sir William White, who furnished them with an outline design of the internal arrangements and a specification covering all the requirements of the service, at the same time leaving the builders a free hand as to the form of the vessel, power of propelling machinery, and other details. The twenty miles distance starting from rest was steamed by the *Curzon* in 65 minutes,

equal to a mean speed of 18.46 knots. The time occupied by the *Hardinge* was 66½ minutes, equal to 18.045 knots. The mean shaft horse-power was 2390, and the consumption of steam for turbines only 12.55 pounds per hour per shaft horse-power. The consumption of steam by the auxiliaries amounted to nearly 3 pounds per hour per shaft horse-power of main engines.

Cruising Turbine.—Mr. Harold Yarrow described "A Device to Facilitate the Coupling of Cruising Turbines." He said that owing to the uneconomical performance of turbines when developing powers considerably below full power, attention had recently been directed to improving the economy of vessels when cruising at low speeds by the introduction of special motors, such as turbines, internal combustion engines, or reciprocating steam engines. The use of a friction clutch on board ship might lead to difficulties, especially in view of the comparatively large powers that had to be transmitted. The simple and more direct method was by throwing in and out of gear a dog clutch, so that the cruising motor could be coupled up or not as desired. When a high speed was demanded it was contemplated that the main turbine only would be working, and when a cruising speed was required the cruising motor only would be working, the main turbine in this case being simply driven round by the cruising motor. If the cruising motor consisted of a steam turbine, the exhaust from it could of course be utilized in the main turbines to assist in the propulsion of the vessel.

Electric Propulsion.—Messrs. John Reid and H. A. Mavor presented "A Case for Electric Propulsion." The writers urged that the development of the canal barge or freighter presented a problem of great interest, and endeavored to show how important and indeed indispensable for reliability and efficiency the use of electric transmission might be in the propulsion of so relatively simple a type as the Canadian barge, where it was decided to adopt the Diesel engine. This should help to dispose of the too prevalent idea that the natural scope for electric propulsion was in warships, or other highly specialized vessels, in which electricity might provide means for adjusting economically the power generated to the very conflicting power requirements under peace and war conditions. Undoubtedly a battleship or battle-cruiser did offer the very best scope for the electric drive, but only because that class of vessel presented on a large scale the same problems in propulsion which were found in almost all other vessels, namely, how to adjust efficiently and economically the power available to the power required at any given time, not necessarily always from the point of view of propulsion alone. Nothing was more likely to retard the introduction of the internal combustion engineering marine work than the mistaken attempt to treat it as a perfect substitute for the triple expansion engine which it was intended to displace. It was at this point that electricity acted as a safeguard in a way that no other system of transmission could approach. The success which had attended the introduction of the geared turbine and the hydraulic transformer was of good augury for similar success with electric transmission.—*Naval and Military Record.*

OIL FUEL IN THE ENGLISH NAVY.—Extracts from a speech of the First Lord:

In 1909 the first flotilla of ocean-going destroyers wholly dependent upon oil fuel was created, and there are now built and building more than a hundred destroyers, inclusive of coastal destroyers, wholly dependent upon oil fuel. In the last five years oil has also been employed in coal-burning battleships and cruisers to enable them to realize their full power in an emergency. In 1911 there were 150 vessels built or building dependent wholly, or partially, upon oil, and provision has been made from year to year both for the storage of oil and of building up oil reserves. No difficulty had been experienced in buying the oil needed. The supply, storage, and distribution of oil has not presented any serious difficulty. The price of

oil was practically equal to that of coal; in short, our partial reliance upon oil fuel was already established when he came into office as a policy, and its development was being actively pursued in the interests alike of the economy and efficiency of the naval service.

Advantages of Oil.—There is no doubt that, with otherwise similar warships, the one that burnt oil possesses a large excess of speed over that which burnt only coal, and even over that which burnt coal and oil. The radius of action of a ship-of-war that used oil instead of coal is increased by nearly 40 per cent for the same weight of fuel. Moreover, oil can be stored in some places in a ship from which it would be practically impossible to bring coal to the furnaces, with the consequence that the radius of action is increased. Oil bunkers could be replenished with great speed without affecting the operations of the ship and with few men, whereas coaling is a laborious task which necessitates the exertion of the whole crew, with the result that the men are physically exhausted by the effort, and the ship is for the time rendered unfit to fight. The saving of labor involved in retrimming and stoking, as well as in removing ashes, clinkers, and soot when coal is burnt, enabled a large reduction of the personnel in the stokehold. In a coal-burning ship, when part of the coal has been used, the ship cannot attain great power without placing an undue amount of labor on the rest of the personnel, who have to be called from other duties to trim coal from remote and probably inconveniently placed bunkers, whereas oil is supplied to the furnaces with continuity and facility until the whole has been consumed. The use of oil fuel makes it possible to produce a type of war vessel which will fulfil the given conditions of speed and armament, of lesser dimensions, and consequently at smaller cost than can be done with coal. The great advantage which liquid fuel possesses is the solving of the problem of naval design. It makes it possible to obtain vessels of very high speed compared with their dimensions, of a speed, that is to say, compared with their dimensions, which can never be attained if coal remains the only fuel.

The Sea-Keeping Factor.—All these advantages which are attendant upon the use of oil can be reaped by any other nation which chooses to have them, but there is one great special advantage which oil confers upon the British fleet which is not enjoyed by any weaker naval power. A strong naval power must keep the seas continuously, and not be forced to leave its fighting position in order to refuel, but a weaker fleet can bide its opportunity in port. Recoaling imposes a continuous strain upon a strong fleet without any corresponding strain upon the weaker fleet. Oil, which can be fed so easily from one vessel to another, would add appreciably to the percentage of the fighting strength of the British Navy without a corresponding reduction in other directions.

Sources of Supply.—Now I come to the quantity of oil, and the resources of oil, which are at our disposal in the world. There is plenty of oil in the world. The total output of crude oil last year was nearly 50,000,000 tons. The total consumption of the navy last year was less than 200,000 tons. We can, or shall soon, be able to draw our oil supplies from Burma, California, Persia, Texas, Roumania, Borneo, Egypt, Mexico and Trinidad. Apart from this—the natural supplies of oil which come up in the form of oil from below the ground—there are processes of manufacturing oil from other substances which are numerous, important, and rapidly increasing. The most promising feature of recent investigations is the great potentiality of the home supply. It is calculated that the Scottish shales if developed to their fullest capacity would yield between 400,000 and 500,000 tons in 150 years. Immense deposits of clay containing oil-bearing seams stretch across our country from Dorsetshire to Lincolnshire, and there are extensive shale beds in Nova Scotia and New Brunswick. It would be foolish to suppose that the wealth of Britain cannot command from the vast oil resources of the world the comparatively modest supply which even at its maximum the navy would require. The problem is not one of quantity,

but of price. We are entering into a field of operations full of intricate and novel features, in which a government department will require in a special degree confidence and support if it is to make sure, thrifty, and judicious arrangements in the public interest.

OIL-FUEL SUPPLY.—Dealing with the question of oil fuel for the navy, the *Petroleum World* estimates the requirement of the fleet at not less than 1,000,000 tons of liquid fuel per annum independent of the present production, which is practically all in private hands. To obtain this quantity of liquid fuel not less than 1,500,000 tons of crude production per annum will, it says, be requisite. Supposing that we are fortunate enough to get wells which on the average give 10 tons per day 300 days in the year we shall want 500 wells always producing, with other wells drilling and reserve territory for future development. The Crown in the Crown colonies and the various governments in the self-governing colonies have considerable areas of possible oil-bearing land. Some are known to be rich in petroleum. For example, certain parts of Trinidad; other parts of it may be—for instance, portions of British India, Australia, New Zealand and British New Guinea. —*The Engineer.*

THE WORKING OF MOTOR SHIPS. THE "CHRISTIAN X."—This vessel is a sister ship of the *Jutlandia* and *Selandia*, and she was originally built under the name *Fionia* by Burmeister & Wain for the East Asiatic Company, but before she had been to sea she was taken over by the Hamburg-Amerika Company and renamed. She has a deadweight capacity of 7400 tons, and is fitted with two sets of eight-cylinder four-cycle motors, which are designed to develop together a total of 2500 horse-power. She is, therefore, by no means a small vessel, and her engines are, at any rate, not less powerful than would be the engines of a similar sized steamship. In fact, the *Christian X*, and her sister vesssels may be taken as excellent examples of present-day long-voyage cargo-carrying motor ships. The *Christian X* started from Hamburg on her maiden voyage on July 23 last year, and from the time the engines were put to full speed ahead, there was no stoppage till Havana was reached on August 9. The voyage represented a distance of 4627 nautical miles, and it was accomplished in 17 days 12 hours 14 minutes, or at an average speed of 11.01 knots. The ports of Vera Cruz, Tampico, Donna Cecilia, Coatzacoalcos, New Orleans and New York were then visited in turn, and, between the two last-named places, the distance—1613 nautical miles—was covered at the rate of 12.92 knots. On the way home from New York very bad weather and heavy head winds were encountered, which necessitated slowing up during part of the time, yet the speed over the 3625 nautical miles to Hamburg averaged 9.58 knots, though at one time it had to be reduced to 5.9 knots. This, be it said, had nothing to do with the engines. It was merely a measure of precaution so that the ship might be safely held to her course. The engines throughout behaved, we are told, admirably. They were opened up when Hamburg was again reached, and it was then found that practically nothing was the matter with them, with the exception that the seats of two of the valves required attention.

In the table that details the voyages it is seen that the vessel starting on a maiden voyage sailed a total distance of 11,894 nautical miles at an average speed of 10.89 knots with no stoppage due to the machinery, saving that of 8 minutes for cleaning out the oil filters. Much of the journey was done at over 12 knots, and had it not been for very fierce weather in the Atlantic on the way home, the average speed would have been considerably higher—at any rate, well over 11 knots. It must be admitted that this is a very satisfactory record. The consumption of fuel is no less noteworthy. Leaving aside altogether the trial run of twenty-four hours which was made on the voyage out, and when an over-all consumption of 0.361 pound of Roumania oil per indicated horse-power was found, there is the average consumption for the whole trip of 0.169 kilowatt, or 0.372 pound, per horse-

power-hour. For the sake of comparison, we may say that the *Selandia's* consumption worked out on trial at 0.366 pound per horse-power-hour. The total quantity required for the round trip of the *Christian X* was 505.4 tons, and this figure covers not only the consumption of the main engines and auxiliaries during the whole voyage, but also that used in maneuvering and that required by the auxiliary machinery when in harbor. It should be borne in mind that the tons are metric tons, and that the metric ton weighs 36 pounds less than the English ton. The 505.41 tons equal nearly 1,115,000 pounds, so that the actual consumption per miles traveled was on the average rather more than 90 pounds. This is a figure worth remembering. A vessel with a deadweight capacity of 7400 tons can be propelled at an average speed of just under 11 knots over a considerable distance for a fuel consumption of just over 90 pounds per nautical mile. The day's consumption averaged out at 9¾ metric tons, and this figure also represents the total consumption—that of the main engines and auxiliaries. These data will be of value for comparative purposes, and they may, apparently be accepted with confidence. They are not merely results obtained in tests conducted under special conditions, but those found during a run covering nearly 12,000 sea miles with a not inconsiderable amount of bad weather. There are other figures in the table which will be found of interest as giving an insight into what may be expected with a large cargo vessel driven by Diesel engines, but we need not refer to them in detail.

The report brings out another point, and that is that the question of the quality of oil is of paramount importance. We learn, for example, that an oil with a calorific value of 17,900 B.Th.U.'s could be bought in a Central American town for 33s. per ton—a price at which, by the way, a horse-power-hour on the *Christian X* would work out at about 0.067d. With this oil the engines ran quite well, but the fuel was suspected of containing too much sulphur, and its use was temporarily, at any rate, discontinued. For a motor ship to load up with oil which it subsequently found it could not use without seriously injuring its engines would be a calamity. Then, again, in another voyage some oil was shipped which caused too early ignition, when the engines were running slow and the Aspinall governors were constantly at work. From this cause the valves hung open and some of them got spoilt. This mishap necessitated putting back to port for repairs and adjustments and consequent delay. Had the defect not been found out when it was, it might have led to the disabling of the ship in mid-ocean. These two examples of what has occurred to one vessel show how necessary it is that stores of suitable oil should be established at as many points as possible. The motor ship has certainly come to stay. Every year more vessels of this type will start running, and the demand for oil will increase accordingly. At present such ships have to pick and choose their ports in order that oil may be obtained; and even then, as the report shows, they sometimes do not get oil of the requisite quality. It would certainly appear advisable that one of the qualifications of the engineer of the motor ship of the future should be the ability to analyze the oil; or, at any rate, to test it in such a manner that its suitability or otherwise might be rapidly determined. That the *Christian X* had to put back to port for repairs and adjustments because of the unsuitability of the oil indicates a certain amount of unpreparedness which, we imagine, will not exist in the future. Having learned one of the troubles which may be anticipated, the owners of motor ships will make provision for it. Had there been facilities for testing the oil, or had there been on board the requisite appliances for making the necessary alterations so that the oil could be used without trouble, the loss of time actually experienced would have been avoided. The industry at the present time is really in its very early stages, though it is astonishing what strides have been made during the last few years. It is too soon, as yet, for arrangements, such as exist where coal is concerned, to have been made, but we have little doubt that in the near future the oil companies on the one hand and the motor shipowners on the other will have come to such agreements

that oil suitable in every way for the purpose will be obtainable practically wherever it is wanted, just as, at present, is coal.—Editorial in *The Engineer.*

COMPARATIVE TRIAL BETWEEN TRIPLE-EXPANSION ENGINES AND TURBINES.—The table below gives the results in the cases of two absolutely identical vessels, the *Cairnross* and the *Cairngowan.*

The following tabular matter is the summary of 36 hours trial:

	Cairnross. Geared Turbine.	*Cairngowan.* Triple Expansion.
Revolutions per min. (mean of 36 hr.)	61.76	61.68
Coal per day	27.8 tons	32.7 tons.
I. H. P.	....	1,790
S. H. P.	1,570	....
Ratio of s.h.p. *Cairnross* to i.h.p of *Cairngowan*	87.7 p.c.	....
Lbs. of coal per i.h.p. hr. all purposes	1.45 lb.	1.704
Lbs. of coal per s.h.p. hr. all purposes	1.65 lb.	1.94 lb.
Estimate of water consumption per hour all purposes	22,000 lb.	27,200 lb.
Estimate of water consumption per i.h.p. hr.	12.3 lb.	15.18 lb.
Estimate of water consumption per s.h.p. hr.	14 lb.	17.3 lb.
Hot well temperature	79 deg. F.	104 deg. F.
Feed temperature	203 deg. F.	221 deg. F.
Estimate lb. of water per lb. of coal (from feed temperature)	8.5 lb.	8.97 lb.
Percentage of ash	12.5 p.c.	9.50 p.c.
Pressure, steam pipe in engine room	1.50 a.	175 lb.
Initial pressure, H. P. turbine	1.38 lb.	....
Vacuum	28.75 in.	26.8 in.
Circulating water inlet	50 deg. F.	50 deg. F.
Circulating water outlet	70 deg. F.	95 deg. F.

—*Marine Engineer and Naval Architect.*

RADIO.

THE HETERODYNE RECEIVER.—An important improvement in wireless apparatus, used in connection with the recent tests between the scout cruiser *Salem* and the Arlington station, was the newly invented heterodyne receiver, which employs a new principle for which much is claimed in the way of solving the problems of long-distance transmission and non-interference reception.

The fundamental principle underlying the operation of the heterodyne receiver is the production of interference "beats" between oscillations received from a distant station and similar oscillations, having a slightly different frequency, produced locally at the receiving station. The action is analogous to musical "beats" between two vibrating strings having nearly the same pitch.

The heterodyne receiving set employed in the tests between the *Salem* and Arlington consisted of an oscillating arc with suitable coils and condensers and a transformer connection between the ship's antennæ and the local circuit for superposing the local oscillations upon those received from the distant station. The resultant of these slightly different oscillations was passed by means of an oscillating transformer through a rectifying detector to a pair of ordinary wireless telephones.

If the local oscillations are of the same frequency as those from the distant station, nothing will be heard in the telephones. If they be slightly different, a low-pitched note will be heard. As this difference is increased, the pitch of the note is correspondingly increased until the limit of audibility is reached. These changes of pitch are made by varying the inductance or capacity in circuit with the oscillating arc.

Owing to the heterodyne operating as the resultant of these two sources of power, it is possible to amplify the received signals considerably by changing the local energy. This is of material advantage, as it greatly increases the reliability of the incoming signals.

Another important advantage of the heterodyne is that amplification is only given to the signals it is desired to receive, as all others would be outside of the effective range of frequency. This peculiar advantage of the heterodyne also tends to protect the home apparatus against interference from atmospheric disturbances.—*The Navy.*

AVIATION.

GERMAN NAVY AIRSHIPS.—A naval airship and a number of hydroplanes took part in the German naval maneuvers this spring. The airship was removed from Hamburg on April 1, and taken to the maneuvers area. A 40,000 candle-power searchlight was fitted on the fore-car of the airship capable of lighting up the surface of the sea from a height of 1500 meters. A series of night experiments to demonstrate the practicability of searchlight observation from an airship will begin shortly.

ENGLISH AIRSHIP.—The German-built Parseval airship, which has been acquired for the Royal Navy, was launched at Farnborough on Monday afternoon, under the most favorable climatic conditions. The vessel is nearly 300 feet long, and has a lifting power of 8½ tons. The car which carries a crew of ten, is fitted with engines of 360 horse-power. Commander Masterman, commandant of the Naval Wing of the Royal Flying Corps, was on board, and a flight of 2½ hours was made before the airship was taken over by the authorities. Her maximum speed is 52 miles an hour, and her endurance 15 hours. In the evening the new airship went off on a hundred miles flight. Flying well, she proceeded in the direction of London, and was seen over Westminster traveling at a high speed. She then went away in a southwesterly direction.

The Parseval airship returned safely to Aldershot after a very fine flight, during which the war office and Admiralty were circled. No difficulty of any kind was experienced during the trip. When she came to earth on Farnborough Common the wind had greatly freshened, and it was decided to anchor her on the common until the wind moderated rather than risk an accident in housing her in her narrow shed.

Her official dimensions are given as follows: Length of gas envelope, 290 feet; width, 46 feet; displacement, 8½ tons; two Mayback motors of 180 horse-power each; lift of crew, stores, gun, wireless apparatus, 2½ tons; highest speed, 42½ miles per hour; endurance, 15 hours, or 30 hours at 33 miles per hour.

THE NEW SCHÜTTE-LANZ AIRSHIP.—The second Schütte-Lanz airship of the German Army, known as the *S. L. 2*, which has been built under Professor Lanz's directions at Mannheim, is now practically completed and will be placed in commission during the present month. Improvements have been made in comparison with the first airship of this type, with a view to securing greater stability combined with less weight. The new airship contains 847,000 cubic feet of gas, and has five cars, one for the commander in front and four for the crew. Of the latter, two hang loosely in the center line fore and aft, while the remaining two are fixed rigidly in the middle on each side of the center line. The airship has four motors, three Maybach and one Daimler, each with two propellers. It is estimated that *S. L. 2* will attain a speed of about forty-five miles an hour. It is stated that a third airship of this type will be constructed for the German Army by the spring of next year. Up to the present the German Army has increased its supply of airships this year by eight, viz: four Zeppelins, two Parsevals, one Schütte-Lanz and one airship of the *M* type, making a total of thirteen dirigibles now at its disposition.—*The Engineer.*

The foreign press seems to have abandoned the word hydroaeroplane altogether, the words hydroplane, seaplane, waterplane and hydrovol being used in its place.

GERMAN BUDGET.—On June 26 the Reichstag voted without debate a supplementary navy budget providing for a naval program of two airship squadrons each composed of four dirigibles in service and of one in reserve, and seven aviation stations.

MISCELLANEOUS.

NOTES ON THE BALKAN WAR.—The treaty of London between Turkey and the Balkan States has been followed by a fierce war between the former allies over the possession of various points. The reports have been too vague to follow any campaign and in fact there seems to have been no regular plan on the part of any state engaged. Roumania joined the fight. Much severe fighting has taken place, heavy losses on both sides occurring. Charges and countercharges of brutality occur. The numerous guerrilla bands have kept the non-combatant people in a state of frenzy. No crops have been planted, there are no harvests to make and the Balkan States will probably require large amounts of food supplies when winter comes.

On August 10 peace treaties were signed by the different states and it is possible that internal strife may be ended. The Turks, however, entered the lists and recaptured Adrianople and refuse to give it up treaty or no treaty.

Emperor William created King Constantine of Greece a general field marshal of the German Army and conferred upon the Greek crown prince the Grand Cross of the Red Eagle.

Emperor William also conferred the Grand Cross of the Order of the Red Eagle on the Roumanian premier, Titu Majeresco, president of the Balkan Peace Conference at Bucharest, in recognition of service to the cause of peace.

The correspondent of *Corriere della Sera*, Rome, who has visited the chief centers of the Balkan War, makes the first complete and careful estimate of the losses in life and money. In the war with Turkey, Bulgaria lost 80,000 men, he estimates; Servia, 30,000; Greece, 10,000; Montenegro, 8000, and Turkey, 100,000. In the war between the Balkan States Bulgaria has lost 60,000 men, Servia 40,000 and Greece 30,000. He is convinced that in both conflicts 400,000 men must have perished, and the cost to the various nations involved aggregates $1,360,000,000—and not one is rich either in money or men.

THE KAISER WILHELM CANAL.—The British consul-general at Hamburg reports that the work of widening and deepening the Kaiser Wilhelm Canal is nearing completion, and that the canal will be open to the largest ships probably by October next. The new line of the canal is a considerable modification of the old one with the result that two islands have been formed, one of which is to serve as a coaling station. The navigable channel is 45½ feet deep throughout the whole length of the canal. Railway lines have had to be diverted, and the line of Flensburg will be carried over the canal by a high level bridge, 146 feet above the level of the water.

The alterations made in this canal which was built in 1895 are: The bottom width of the canal is doubled to 144 feet, the depth is increased to 36 feet at ordinary canal level; giving a water-level width of 335 feet, instead of 66 meters, and a canal profile of 8880 square feet, instead of 413 square meters. There are some rather awkward curves near the Kiel end of the canal; the minimum radius of curvature will be more than 1 mile, and of that there will be only very few cases; most of the curves will have a radius of more than 3000 meters. The ten passing places will have length of from 600 meters to 1100 meters and of 1400 meters, and bottom widths

of 134 meters and 89 meters (437 feet and 292 feet); the latter figure concerns spots where ships may pass on both sides of the mid-water line. The locks have a useful length of 1083 feet, a width of 147.6 feet, and a depth of 45¼ feet; this depth will meet any later deepening of the canal bed. Each lock will be fitted with three sliding-gates, each weighing 1000 tons, to be worked by electricity; the middle gate is to serve for dividing the huge lock-chamber into two chambers of 100 meters and 221 meters useful lengths, which will in many cases be a sufficient length. The new locks will require new and spacious dock basins.

THE "IMPERATOR."—The Hamburg-Amerika liner *Imperator*, which left Cuxhaven at three in the afternoon of June 11, arrived at Sandy Hook at ten in the evening of June 18. Both times are given according to British reckoning. She was built by the Stettiner Maschinenbau Aktien-Gesellschaft Vulcan at Hamburg, where she was launched by H. I. M. the German Emperor on May 23, 1912. On her voyage across the Atlantic she carried approximately 3550 passengers and a crew of 1180. The weather experienced was on the whole far from good, and for two days heavy storms were encountered, whilst for a period of twenty-four hours she was delayed by fog. In spite of the fact that the wind at times registered more than force 10, so steady is the ship that many of the passengers were quite unaware of its strength. The docking operations in New York occupied fifty minutes. The *Imperator* is the largest vessel afloat. She is 920 feet 6 inches long over-all with a breadth of 98 feet. Her height from boat-deck to keel is 100 feet 4 inches. Her gross registered tonnage is 52,117 tons, and her displacement when fully laden is 57,000 tons, her draft then being 35 feet 6 inches. She has boat accommodation for 5500, whereas the total number of passengers and crew which she can carry is 5200. The four four-bladed propellers which drive the ship make normally 175 revolutions per minute, giving her a speed averaging 22½ knots. They can, however, be speeded up to 185 revolutions to produce a speed of rather over 23½ knots. The propelling machinery consists of turbines of the combined impulse and Parsons' type, having a total ahead horse-power of 62,000 and astern power of 35,000. —*The Engineer.*

"SUCTION" OR INTERACTION BETWEEN PASSING VESSELS.—Professor A. H. Gibson, D. Sc., and J. Hannay Thompson, M. Sc., present in *The Engineer* of July 4, 1913, an interesting and exhaustive article on this subject deriving the following general conclusions from a great number of experiments:

In general the greater the difference between the speeds of the vessels the smaller is the risk of collision, since such a difference reduces the time during which the mutual forces are operative, such an effect being much more marked when the smaller vessel is the faster. If the larger vessel is the faster, particularly if her speed be accelerated while passing the smaller, the attractive forces are increased to an extent which partially, and in some cases entirely, counterbalances the effect of the reduction in the time during which the vessels are in dangerous proximity. It follows that any attempt of the larger vessel to draw ahead of the smaller by increasing her speed, while in close proximity, greatly increases the risk of collision.

With vessels of the relative size used in these experiments, moving at speeds within 10 per cent of each other, collision may be produced from a lateral distance as great as 3½ lengths of the smaller vessel, except in so far as prevented by helm action. The greater the draft of the attracted vessel for a given displacement and length the greater the probability of ultimate collision. The smaller the attracted vessel within limits the smaller is the angle of impact under given conditions, while the greater the lateral distance from which collision is produced the more direct and dangerous is the resultant impact.

On the whole, the results of the trials show that under certain circumstances interaction is a very real danger to navigation, even in deep and

open waters. With ordinary vessels of the relative sizes adopted for the experiments, if the possibility of interaction is realized from the very first, and if all initial swerve is prevented by an early application of the helm, there would appear to be little danger even at lateral distances so small as one-half the length of the smaller vessel, but once such a swerve has been initiated a much greater helm angle is necessary to control the vessel, and, failing immediate control, collision occurs within comparatively few seconds.

ANGLO-AMERICAN EXPOSITION.—Under the patronage of His Royal Highness, the Duke of Connaught, and the Honorary Presidency of His Highness, the Duke of Teck, will be held an Anglo-American Exposition (May to October, 1914) in London, in the permanent Exposition Grounds and buildings covering 150 acres, in celebration of the centenary of peace between the two nations and to demonstrate the progress which has been made during that century in the arts, sciences and industries by the people of both countries.

The Anglo-American Exposition was inaugurated at a meeting of the American Society in London at which His Excellency, the late American Ambassador, Mr. Whitelaw Reid, presided, and confirmed at a meeting held at the Mansion House last March under the Presidency of the Lord Mayor of London, when, amongst other resolutions in support of the exposition, the following was also unanimously passed, "That all profits derived from the Anglo-American Exposition, 1914, by the committee shall be devoted to some public objects of national utility to the United Kingdom and the United States." As a result of the meeting at the Mansion House, a deputation proceeded to Washington where they were cordially received by President Wilson and the members of his cabinet.

LIST OF PRIZE ESSAYS.

1879.

Naval Education. Prize Essay, 1879. By Lieut.-Com. A. D. Brown, U. S. N.

NAVAL EDUCATION. First Honorable Mention. By Lieut.-Com. C. F. Goodrich, U. S. N.

NAVAL EDUCATION. Second Honorable Mention. By Commander A. T. Mahan, U. S. N.

1880.

"The Naval Policy of the United States." Prize Essay, 1880. By Lieutenant Charles Belknap, U. S. N.

1881.

The Type of (I) Armored Vessel, (II) Cruiser best suited to the Present Needs of the United States. Prize Essay, 1881. By Lieutenant E. W. Very, U. S. N.

SECOND PRIZE ESSAY, 1881. By Lieutenant Seaton Schroeder, U. S. N.

1882.

Our Merchant Marine: The Causes of its Decline and the Means to be taken for its Revival. "Nil clarius aquis." Prize Essay, 1882. By Lieutenant J. D. J. Kelley, U. S. N.

"MAIS IL FAUT CULTIVER NOTRE JARDIN." Honorable Mention. By Master C. G. Calkins, U. S. N.

"SPERO MELIORA." Honorable Mention. By Lieut.-Com. F. E. Chadwick, U. S. N.

"CAUSA LATET: VIS EST NOTISSIMA." Honorable Mention. By Lieutenant R. Wainwright, U. S. N.

1883.

How may the Sphere of Usefulness of Naval Officers be extended in Time of Peace with Advantage to the Country and the Naval Service? "Pour encourager les Autres." Prize Essay, 1883. By Lieutenant Carlos G. Calkins, U. S. N.

"SEMPER PARATUS." First Honorable Mention. By Commander N. H. Farquhar, U. S. N.

"CULIBET IN ARTE SUA CREDENDUM EST." Second Honorable Mention. By Captain A. P. Cooke, U. S. N.

1884.

The Reconstruction and Increase of the Navy. Prize Essay, 1884. By Ensign W. I. Chambers, U. S. N.

1885.

Inducements for Retaining Trained Seamen in the Navy, and Best System of Rewards for Long and Faithful Service. Prize Essay, 1885. By Commander N. H. Farquhar, U. S. N.

1886.

What Changes in Organization and Drill are Necessary to Sail and Fight Effectively Our Warships of Latest Type? "Scire quod nescias." Prize Essay, 1886. By Lieutenant Carlos G. Calkins, U. S. N.

THE RESULT OF ALL NAVAL ADMINISTRATION AND EFFORTS FINDS ITS EXPRESSION IN GOOD ORGANIZATION AND THOROUGH DRILL ON BOARD OF SUITABLE SHIPS. Honorable Mention. By Ensign W. L. Rodgers, U. S. N.

1887.

The Naval Brigade: its Organization, Equipment and Tactics. "In hoc signo vinces." Prize Essay, 1887. By Lieutenant C. T. Hutchins.

1888.

Torpedoes. Prize Essay, 1888. By Lieut.-Com. W. W. Reisinger, U. S. N.

1891.

The Enlistment, Training and Organization of Crews for our Ships of War. Prize Essay, 1891. By Ensign A. P. Niblack, U. S. N.

DISPOSITION AND EMPLOYMENT OF THE FLEET: SHIP AND SQUADRON DRILL. Honorable Mention, 1891. By Lieutenant R. C. Smith, U. S. N.

1892.

Torpedo-boats: their Organization and Conduct. Prize Essay, 1892. By Wm. Laird Clowes.

1894.

The U.S.S. Vesuvius, with Special Reference to her Pneumatic Battery. Prize Essay, 1894. By Lieut.-Com. Seaton Schroeder, U. S. N.

NAVAL REFORM. Honorable Mention, 1894. By Passed Assistant Engineer F. M. Bennett, U. S. N.

1895.

Tactical Problems in Naval Warfare. Prize Essay, 1895. By Lieut.-Com. Richard Wainwright, U. S. N.

A SUMMARY OF THE SITUATION AND OUTLOOK IN EUROPE. An Introduction to the Study of Coming War. Honorable Mention, 1895. By Richmond Pearson Hobson, Assistant Naval Constructor, U. S. N.

SUGGESTIONS FOR INCREASING THE EFFICIENCY OF OUR NEW SHIPS. Honorable Mention, 1895. By Naval Constructor Wm. J. Baxter, U. S. N.

THE BATTLE OF THE YALU. Honorable Mention, 1895. By Ensign Frank Marble, U. S. N.

1896.

The Tactics of Ships in the Line of Battle. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorable Mention, 1896. By Lieutenant Wm. F. Fullam, U. S. N.

NAVAL APPRENTICES, INDUCEMENTS, ENLISTING AND TRAINING. The Seaman Branch of the Navy. Honorable Mention, 1896. By Ensign Ryland D. Tisdale, U. S. N.

THE COMPOSITION OF THE FLEET. Honorable Mention, 1896. By Lieutenant John M. Ellicott, U. S. N.

1897.

Torpedo-boat Policy. Prize Essay, 1897. By Lieutenant R. C. Smith, U. S. N.

A PROPOSED UNIFORM COURSE OF INSTRUCTION FOR THE NAVAL MILITIA. Honorable Mention, 1897. By H. G. Dohrman, Associate Member, U. S. N. I.

TORPEDOES IN EXERCISE AND BATTLE. Honorable Mention, 1897. By Lieutenant J. M. Ellicott, U. S. N.

1898.

Esprit de Corps: A Tract for the Times. Prize Essay, 1898. By Captain Caspar Frederick Goodrich, U. S. N.

OUR NAVAL POWER. Honorable Mention, 1898. By Lieut.-Com. Richard Wainwright, U. S. N.

TARGET PRACTICE AND THE TRAINING OF GUN CAPTAINS. Honorable Mention, 1898. By Ensign R. H. Jackson, U. S. N.*

1900.

Torpedo Craft: Types and Employment. Prize Essay, 1900. By Lieutenant R. H. Jackson, U. S. N.

THE AUTOMOBILE TORPEDO AND ITS USES. Honorable Mention, 1900. By Lieutenant L. H. Chandler, U. S. N.

1901.

Naval Administration and Organization. Prize Essay, 1901. By Lieutenant John Hood, U. S. N.

1903.

Gunnery in Our Navy. The Causes of its Inferiority and Their Remedies. Prize Essay, 1903. By Professor Philip R. Alger, U. S. N.

A NAVAL TRAINING POLICY AND SYSTEM. Honorable Mention, 1903. By Lieutenant James H. Reid, U. S. N.

SYSTEMATIC TRAINING OF THE ENLISTED PERSONNEL OF THE NAVY. Honorable Mention, 1903. By Lieutenant C. L. Hussey, U. S. N.

OUR TORPEDO-BOAT FLOTILLA. The Training Needed to Insure its Efficiency. Honorable Mention, 1903. By Lieutenant E. L. Beach, U. S. N.

1904.

The Fleet and Its Personnel. Prize Essay, 1904. By Lieutenant S. P. Fullinwider, U. S. N.

A PLEA FOR A HIGHER PHYSICAL, MORAL AND INTELLECTUAL STANDARD OF THE PERSONNEL FOR THE NAVY. Honorable Mention, 1904. By Medical Inspector Howard E. Ames, U. S. N.

1905.

American Naval Policy. Prize Essay, 1905. By Commander Bradley A. Fiske, U. S. N.

THE DEPARTMENT OF THE NAVY. Honorable Mention, 1905. By Rear-Admiral Stephen B. Luce, U. S. N.

1906.

Promotion by Selection. Prize Essay, 1906. By Commander Hawley O. Rittenhouse, U. S. N.

THE ELEMENTS OF FLEET TACTICS. First Honorable Mention, 1906. By Lieut.-Com. A. P. Niblack, U. S. N.

GLEANINGS FROM THE SEA OF JAPAN. Second Honorable Mention, 1906. By Captain Seaton Schroeder, U. S. N.

THE PURCHASE SYSTEM OF THE NAVY. Third Honorable Mention, 1906. By Pay Inspector J. A. Mudd, U. S. N.

1907.

Storekeeping at the Navy Yards. Prize Essay, 1907. By Pay Inspector John A. Mudd, U. S. N.

BATTLE REHEARSALS. A few thoughts on our next step in Fleet-Gunnery. First Honorable Mention, 1907. By Lieut.-Comdr. Yates Stirling, U. S. N.

THE NAVAL PROFESSION. Second Honorable Mention, 1907. By Commander Bradley A. Fiske, U. S. N.

1908.

A Few Hints to the Study of Naval Tactics. Prize Essay, 1908. By Lieutenant W. S. Pye, U. S. N.

THE MONEY FOR THE NAVY. First Honorable Mention, 1908. By Pay Inspector John A. Mudd, U. S. N.

THE NATION'S DEFENSE—THE OFFENSIVE FLEET. How Shall We Prepare It for Battle? Second Honorable Mention, 1908. By Lieut.-Commander Yates Stirling, U. S. N.

1909.

Some Ideas about Organization on Board Ship. Prize Essay, 1909. By Lieutenant Ernest J. King, U. S. N.

THE NAVY AND COAST DEFENCE. Honorable Mention, 1909. By Commodore W. H. Beehler, U. S. N.

THE REORGANIZATION OF THE NAVAL ESTABLISHMENT. Honorable Mention, 1909. By Pay Inspector J. A. Mudd, U. S. N.

A PLEA FOR PHYSICAL TRAINING IN THE NAVY. Honorable Mention, 1909. By Commander A. P. Niblack, U. S. N.

1910.

The Merchant Marine and the Navy. Prize Essay, 1910. By Naval Constructor T. G. Roberts, U. S. N.

THE NAVAL STRATEGY OF THE RUSSO-JAPANESE WAR. Honorable Mention, 1910. By Lieutenant Lyman A. Cotten, U. S. N.

1911.

Navy Yard Economy. Prize Essay, 1911. By Paymaster Charles Conard, U. S. N.

NAVAL POWER. Honorable Mention, 1911. By Captain Bradley A. Fiske, U. S. N.

WANTED—FIRST AID. Honorable Mention, 1911. By Commander C. C. Marsh, U. S. N.

1912.

Naval Might. Prize Essay, 1912. By Lieutenant Ridgely Hunt, U. S. N. (retired).

INSPECTION DUTY AT THE NAVY YARDS. Honorable Mention, 1912. By Lieut.-Commander T. D. Parker, U. S. N.

1913.

The Greatest Need of the Atlantic Fleet. Prize Essay, 1913. By Lieut.-Commander Harry E. Yarnell, U. S. N.

NAVY DEPARTMENT ORGANIZATION. A Study of Principles. First Honorable Mention, 1913. By Commander Yates Stirling, Jr., U. S. N.

TRAINED INITIATIVE AND UNITY OF ACTION. Second Honorable Mention, 1913. By Lieut.-Commander Dudley W. Knox, U. S. N.